WARRANTY

Continental Specialties Corporation warrants this device to be free from defective material or workmanship for a period of ninety (90) days from date of original purchase.

Continental Specialties Corporation under this warranty is limited to repairing or replacing the defective device when returned to the factory, shipping charges prepaid, within ninety (90) days from date of original purchase.

Units returned to Continental Specialties Corporation that have been subject to abuse, misuse, damage or accident; have been connected, installed or adjusted contrary to the instructions furnished by Continental Specialties Corporation or repaired by unauthorized persons will not be covered by this warranty.

Continental Specialties Corporation reserves the right to discontinue models; change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees or agents.

Continental Specialties Corporation shall not be liable in any way for consequential damages resulting from use of this device.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Continental Specialties Corporation is authorized to assume any other obligation in connection with the sale and purchase of this device.

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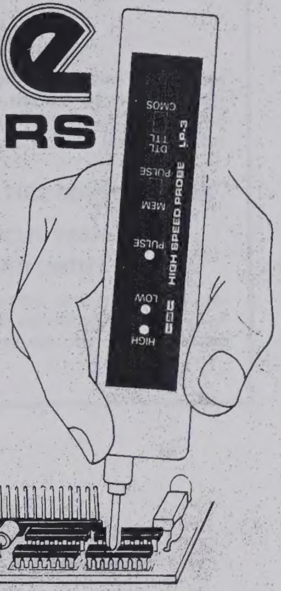
logic probe
IC TESTERS

LP-3



CSC CONTINENTAL SPECIALTIES CORPORATION

INSTRUCTION MANUAL

CONAR TUBE Checker 223

ACCESSORIES

LDA-1	1.5″ Long Tip - Standard.
***LDA-2**	2.5″ Long Tip - Optional.
***LDA-3**	3″ Long E-Z Hook and Adapter for use in place of tip - Optional.
***LDA-4**	3″ Long Ground Clip with E-Z Hook - Optional.
***LDA-5**	3″ Long Ground Alligator Clip. with LP-3 only - Standard. Optional.
***LDA-6**	Test Prod Tip Adapter (Converts tip to E-Z Hook) - Optional.
***LDA-7**	Standard Banana Plug (Converts tip for insertion into Banana Plug) - Optional.
LDA-8	36″ Power/Ground Leads with Alligator Clips - Standard.
***LDA-9**	36″ Power/Ground Leads with E-Z Hooks - Optional.
***LDA-A**	All asterisked items available in kit form.

FACTORY SERVICE AND REPAIR

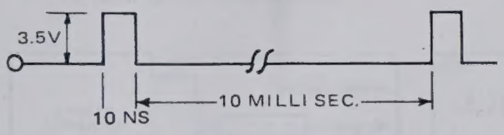
Continental Specialties Corporation will service and repair your LP-3 free of charge for a period of ninety (90) days. (See Warranty) Please return your LP-3, shipping charges prepaid, in its original box with a copy of sales slip or original invoice to:

CONTINENTAL SPECIALTIES CORPORATION
70 FULTON TERRACE
NEW HAVEN, CONNECTICUT 06509
ATTENTION: SERVICE DEPARTMENT

Your LP-3 will be repaired, retested and promptly returned to you. If your LP-3 needs servicing and is out of warranty, follow the above instructions and enclose $10.00 for factory service.

DTL/TTL TEST

1. DTL/TTL – CMOS Switch in the DTL/TTL Position.
2. PULSE/MEM Switch in the Pulse Position.
3. Pulse Generator set to:



4. Pulse LED will flash.

MEMORY TEST

1. PULSE/MEM Switch in the MEM Position.
2. Test in the Pulse Test Circuit.
4. Pulse LED will stay on.

NOTE: The Pulse Detection Circuitry is independent of the DTL/TTL Switch Position.

CATCHING FAST PULSES

The LP-3 contains a unique and highly sensative pulse detecting system capable of catching pulses faster than 10 nanoseconds. This insures capture of glitches and spikes for all logic families: TTL, DTL, HTL, and CMOS.

The pulse detector cirucuit consists of a level sensative broad band amplifier coupled to a high speed pulse stretching monostable multi-vibrator. This circuit is capable of firing on both positive and negative transitions. The pulse stretcher enables a 100 miilisecond oscillator and LED driver circuit that produces a visual indication of pulse catch. The oscillator can also be switched into a bistable mode in order to catch a pulse for "memory".

This technology allows the user to catch and display hidden spikes and glitches that most scopes and logic probes **do not** see.

When catching fast pulses, basic R.F. techniques are necessary.

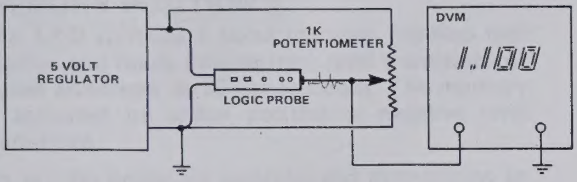
THE LP-3's GROUND LEAD MUST BE USED. Ground lines must be as short as possible. Connect the ground lead of the LP-3 as close to the test point as possible. In the case of an I.C., clip the ground lead directly to the IC ground pin. The ground lead can supply the signal return and negative power line path for the LP-3, and will help prevent ground loops.

TESTING THE LP-3

LOGIC LEVEL TEST

TEST EQUIPMENT NEEDED:

5 Volt Regulated Power Supply
3½ Digit Digital Voltmeter Z Input ≥ 1 Meg
1K Ohm Linear Potentiometer



LOGIC LEVEL TEST CIRCUIT

DTL/TTL TEST

1. DTL/TTL – CMOS Switch in the DTL/TTL Position
2. PULSE/MEM Switch in the Pulse Position
3. Adjust the 1K Potentiometer until the Low LED goes on

   Max. Logic "0" Voltage 0.9 volts
   Min. Logic "0" Voltage .07 volts
4. Adjust the 1K Potentiometer until the HI LED goes on.

   Max. Logic "1" Voltage 2.55 volts
   Min. Logic "1" Voltage 2.10 volts

CMOS TEST

1. DTL/TTL – CMOS Switch in the CMOS Position.
2. PULSE/MEM Switch in the Pulse Position.
3. Adjust the 1K Potentiometer until the LO LED Lites.

   Max. Logic "0" Voltage 1.70 volts
   Min. Logic "0" Voltage 1.35 volts
4. Adjust the IK Potentiometer until the HI LED Lites.

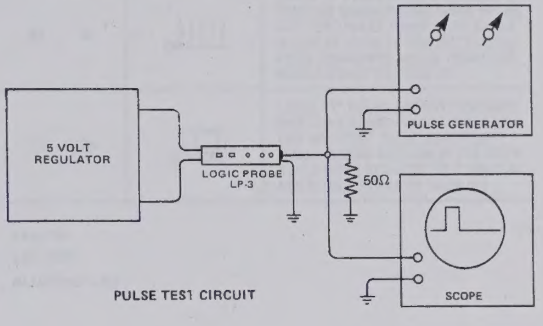
   Max. Logic "1" Voltage 3.85 volts
   Min. Logic "1" Voltage 3.15 volts

To test CMOS Logic Levels above 5 volt Vcc: Refer to CMOS/Vcc Graph on Page 6. Logic Levels should be within ±10% of curves.

PULSE TEST

TEST EQUIPMENT NEEDED:

5 Volt Regulated Power Supply
Pulse Generator E.H. 122A or Equiv.
Scope 250 MHz Band With HP 1720 or Equiv.



PULSE TEST CIRCUIT

immediate indication of the pulse activity at the node under test. By observing the HI and LO LEDs, the polarity of the pulse train can immediately be determined, i.e. of the HI LED is on; the signal is normally high and pulsing low, etc. High frequency signals cause the PULSE LED to flash at a 10 hertz rate.

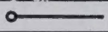
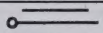
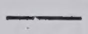
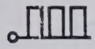
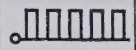
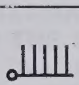
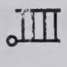
MEMORY/PULSE SWITCH — MEMORY POSITION

The LP-3 contains a pulse memory flip-flop that catches and holds (memorizes) level transitions or pulses as narrow as 10 nanoseconds. The memory is activated by either positive or negative level transitions.

To set the probe for catching and memorizing an event; touch the probe tip to the node under test, move the MEM/PULSE switch to the MEM position. The next event that occurs at the node will activate the PULSE LED and latch it on. To reset and rearm the memory move the MEM/PULSE switch to the PULSE position and then return it to the MEM position.

NOTE: WHEN ARMING THE MEMORY THE PROBE TIP MUST BE IN CONTACT WITH THE NODE UNDER TEST. IF THE MEMORY IS ARMED WITH THE TIP FLOATING (UNCONNECTED) THE MEMORY WILL BE ACTIVATED WHEN THE TIP IS BROUGHT IN CONTACT WITH THE TEST POINT YIELDING A FALSE READOUT.

INTERPRETING THE LEDS

LED STATES			INPUT SIGNAL	
HIGH	LO	PULSE		
○	●	○		LOGIC "0" NO PULSE ACTIVITY
●	○	○		LOGIC "1" NO PULSE ACTIVITY
○	○	○		ALL LEDS OFF 1. TEST POINT IS AN OPEN CIRCUIT. 2. OUT OF TOLERANCE SIGNAL. 3. PROBE NOT CONNECTED TO POWER. 4. NODE OR CIRCUIT NOT POWERED.
●	●	*		THE SHARED BRIGHTNESS OF THE HI AND LO LEDS INDICATE A 50% DUTY CYCLE AT THE TEST POINT. (<1.5MHz)
○	○	*		HIGH FREQUENCY SQUARE WAVE (>1.5MHz) AT TEST NODE. AS THE HIGH FREQUENCY SIGNALS DUTY CYCLE SHIFTS FROM A SQUARE WAVE TO EITHER A HIGH OR LOW DUTY CYCLE PULSE TRAIN EITHER THE LO OR HI LED WILL BECOME ACTIVATED.
○	●	*		LOGIC "0" PULSE ACTIVITY PRESENT POSITIVE GOING PULSES SINCE HI LED NOT "ON" PULSE TRAIN DUTY CYCLE IS LOW RE <15%. IF THE DUTY CYCLE WERE INCREASED ABOVE 15% HI LED WOULD START TO TURN ON.
●	○	*		LOGIC "1" PULSE ACTIVITY PRESENT NEGATIVE GOING PULSES, SINCE LO LED NOT "ON" PULSE TRAIN DUTY CYCLE IS HIGH RE >85% IF THE DUTY CYCLE WERE REDUCED TO <85% "LO" LED WOULD START TO TURN ON.

● LED ON
○ LED OFF
* BLINKING LED

USING YOUR LP-3

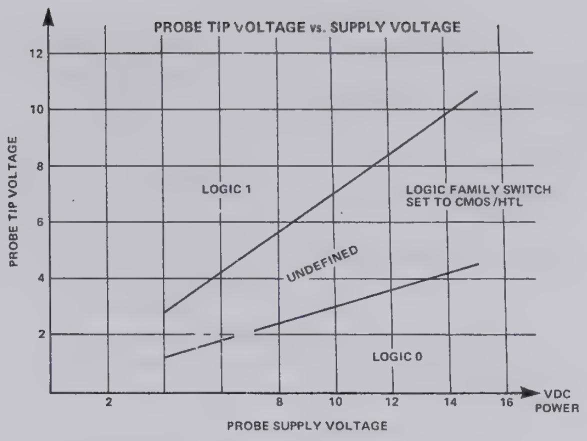
APPLYING POWER TO THE PROBE:

The LP-3 is protected against over-voltage and reverse voltage on its power leads. Connect the black clip lead to the common (—) and the red clip lead to plus (+) Vcc. In order to minimize the possibility of power supply spikes, or other spurious signals from effecting the operation of the probe, connect the power leads and ground lead as close to the node to be tested as possible.

SETTING THE SWITCHES:

Logic Family DTL/TTL — CMOS:

Setting the Logic Family switch to the DTL/TTL position programs the LP-3's window comparator for LOGIC "1" of 2.25 volts ± .15 volts and a LOGIC "0" of 0.8 volts ± .10 volts. In the CMOS position, LOGIC "1" and LOGIC "0" levels are determined by the applied Vcc. LOGIC "1" > 70% Vcc and LOGIC "0" < 30% Vcc. HTL operating at 15 volts have LOGIC "1" and LOGIC "0" thresholds specified at > 8.5 volts and < 6.5 volts. They compare favorably to the 70/30% programming of the LP-3 in the CMOS mode. LOGIC "1" and LOGIC "0" levels can be user defined by using a power source external to the circuit supply.



NOTE: THE COMMON OR GROUND POINT FROM THE EXTERNAL SUPPLY MUST BE CONNECTED TO THE CIRCUIT UNDER TEST COMMON LINE. (See Graph Pg. 6) THIS CAN BEST BE DONE BY CONNECTING THE GROUND LEAD TO TEST CIRCUIT GROUND.

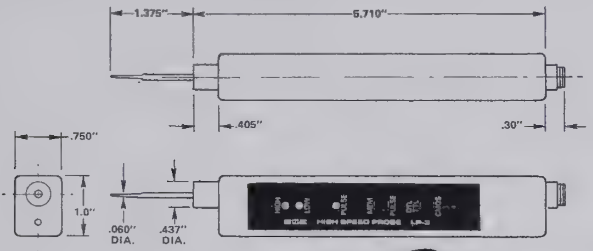
MEMORY/PULSE SWITCH — PULSE POSITION

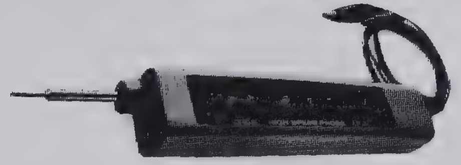
Each time the input signal changes state: i.e. Logic 1 → 0 or Logic 0→1 the pulse LED is activated for 0.1 seconds. When observing low frequency, low duty cycle signals, the PULSE LED provides an

HOW IT IS USED

Just connect the LP-3's clip leads to the circuit's power supply; set the logic family switch to DTL/TTL or CMOS/HTL and the MEMORY/PULSE switch to the PULSE position. Touch the probe tip to the circuit node to be analyzed. The three display LED's on the probe body will instantly provide a reading of the signal activity at the node.

When catching pulses faster than 10 nanoseconds the ground lead should be used. See details under section titled "Detecting Fast Pulses". the memory mode of the LP-3 is used to detect, store and display low rep rate or single shot pulses as well as transient events even when an observer is not available to see them occur.





SPECIFICATIONS

INPUT IMPEDANCE	500,000 Ohms	
THRESHOLDS (Switch Selectable)	DTL-TTL	HTL-CMOS
Logic 1 thresholds (HI-LED)	2.25V ± .015V	70% Vcc
Logic 0 thresholds (LO-LED)	0.80V ± .010V	30% Vcc
MIN. DETECTABLE PULSE WIDTH	10 nanoseconds	
MAX. INPUT SIGNAL FREQUENCY	50 MHz	
PULSE DETECTOR (PULSE LED) (Switch Selectable)	High speed pulse train or single events (+ or — transitions) activate 1/3 second pulse stretcher.	
PULSE MEMORY (PULSE LED) (Switch Selectable)	Pulse or Level transition detected and stored until reset.	
INPUT OVERLOAD PROTECTION	± 50V continuous 117VAC for less than 15 seconds.	
POWER REQUIREMENTS .	5 Volt Vcc	30 Ma
	15 Volt Vcc	40 Ma
	30 Volts max, with power lead reversal protection.	
OPERATING TEMPERATURE	0 to 50 C	
PHYSICAL SIZE L x W x D		
WEIGHT		
POWER LEADS		

CONGRATULATIONS

Your are now part of the growing family of Continental Specialties test equipment owners. Your Multi-Family Logic Probe is a sensitive and unique instrument. In order to obtain maximum benefit from your LP-3, please read this manual carefully.

WHAT IT DOES

CSC's multi-family Logic Probe, LP-3, detects, memorizes and displays logic levels, pulses and voltage transients in mixed and single logic family systems.

It detects out-of-tolerance logic signals, open circuit nodes, as well as transient events down to 10 nanoseconds while providing the user with an instant easily interpreted high-intensity LED readout.

HOW IT WORKS

The probe tip of the LP-3 is connected to a dual threshold window comparator and a bi-polar edge detector. The window comparator bias network establishes the LOGIC "1" and LOGIC "0" threshold levels. The levels are fixed in the DTL/TTL mode (2.25 volts and 0.8 volts) in the CMOS/HTL mode, the thresholds are determined by the applied Vcc voltage – LOGIC "1" > 70% Vcc, LOGIC "0" < 30% Vcc.

The LP-3's pulse detecting system consists of a level adjusted high speed amplifier that drives a bi-polar mono stable pulse stretching circuit. The pulse stretcher converst level transitions as well as narrow pulses to 1/10 of a second pulses that drive one of the three readout LEDs. In the memory mode, the output of the pulse catcher is fed to a latching flip-flop.

logic monitor

CONTINENTAL ● SPECIALTIES

CONTINENTAL SPECIALTIES

LOGIC MONITOR
LM-1

INSTRUCTION MANUAL

CONGRATULATIONS!

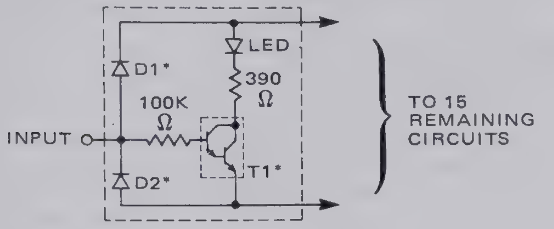
You now own the best circuit design and testing device available. In order to attain maximum benefit from your LM-1 Logic Monitor, please read this manual carefully.

CSC

CIRCUIT DESCRIPTION

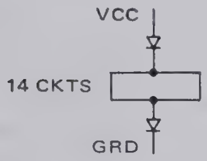
All of the 16 LM-1 circuits are identical and act as buffer amplifiers, comparitors and LED drivers. Selected diode and Darlington transistors insure the device threshold level and LED drive capacity. Each LM-1 is tested for a minimum of twelve hours by an automatic input exerciser (special purpose computer) to insure it meets specifications.

ONE OF 16 CIRCUITS



*Selected components

Assuming one of the 16 input points is connected to Vcc and a second input point is connected to ground, the circuit configuration shown below would be produced.



When any of the remaining fourteen input points is connected to a signal source that exceeds 2 volts the Darlington transistor (selected for β and V_{BE} (sat)) conducts and turns on the LED in its collector. The 100 K resistor in series with the base of each transistor prevents loading of the circuit under test. The 390 ohm collector resistor limits the LED and LM-1 current drain from the IC under test power lines.

PARTS LIST

QUANTITY	DESCRIPTION	CSC PART NO.
1	Plastic Case	CSC-LM-C1
1	Nylon Restraining Web	CSC-LM-NW
2	LED Labels	CSC-LM-LB
2	4-40 x 9/16 FH Screws	4491-601
2	4-40 x 1/4 Hex Nuts	4410.410
2	#4 Internal Tooth Lock Washers	4100.020
2	Printed Circuit Boards	CSC-TC-10
16	Light Emitting Diodes	CSC-LED-3
16	Transistors	CSC-TR-07
16	Type 1 Diodes	CSC-DI-04
16	Type 2 Diodes	CSC-DI-09
16	100,000 OHM 5% 1/4 Watt Resistors	1-100-354
16	390 OHM 5% 1/4 Watt Resistors	1-390-054
1	Instruction Booklet	9-800-010

FACTORY SERVICE AND REPAIR

Continental Specialties Corporation will service and repair your LM-1 free of charge for a period of ninety (90) days. (See Warranty) Please return your LM-1, shipping charges prepaid, in its original box with a copy of sales slip or original invoice to:

CONTINENTAL SPECIALTIES CORPORATION
44 KENDALL STREET
NEW HAVEN, CONNECTICUT 06512
ATTENTION: SERVICE DEPARTMENT

Your LM-1 will be repaired, retested and promptly returned to you. If your LM-1 needs servicing and is out of warranty, follow the above instructions and enclose $10.00 for factory service.

APPLICATIONS

During the design, breadboarding and testing phases of a new logic system the designer usually has full control of the system variables (clock, power supplies, input/output transducers, etc.) and can easily isolate ICs for detailed investigation with the Logic Monitor.

When a logic block needs an additional gate, inverter, flip flop, register; etc. the Logic Monitor can quickly "show" the designer where unused logic elements are located within his system. Nonfunctioning components can easily be located and replaced.

Long-term testing of individual modules can be implemented by merely clipping the LM-1 onto the questionable IC.

Since the entire IC can be monitored simultaneously, direct fast visual correlation of IC inputs and outputs simplifies and expedites signal tracing data transfer and system fault-finding operations.

System and IC reactions to power supply changes, noise and limited temperature* testing are other application areas that make the LM-1 an almost indispensable design tool.

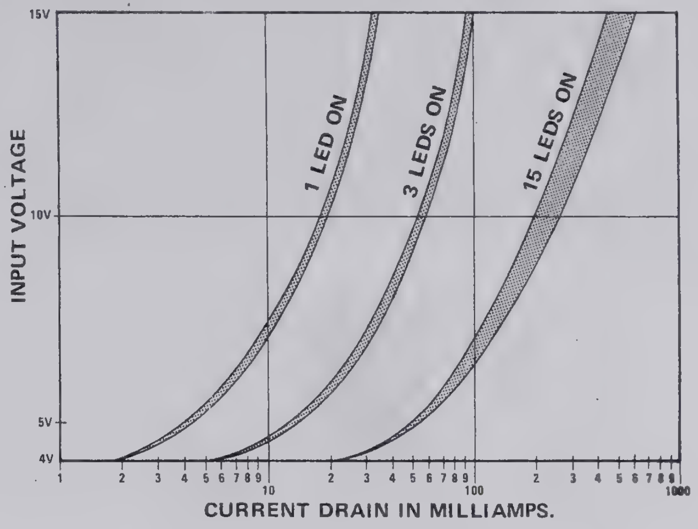
Mixed logic design DTL, TTL, HTL, CMOS, where designers take advantage of individual logic family characteristics: i.e., DTL input, CMOS signal processing and TTL or HTL outputs, are naturals for the LM-1.

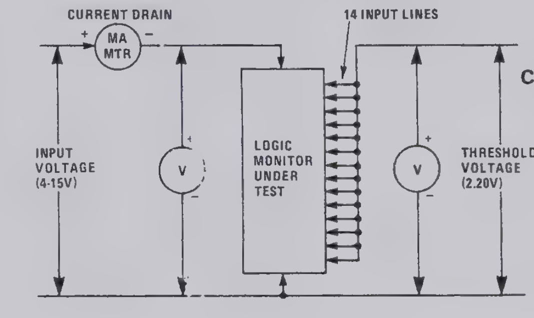
When dealing with multiple PC board systems, again the LM-1 displays its utility. One LM-1 on the inputs or outputs of the driving/receiving board and one on the board under test enable the designer to visually observe the results of any modification or stimulation on one board while his full attention can be directed to the focal point of his investigation.

*See LM-1 Spec.

CAUTION

Be sure the system power supply is capable of providing sufficient current (up to 200 ma @ 10 volts) to drive the Logic Monitor. In most applications only 25% to 50%, four to eight, LEDs are activated and the Logic Monitor supply drain is only 5 to 100 ma depending on the supply voltage. See curves and test diagram below.



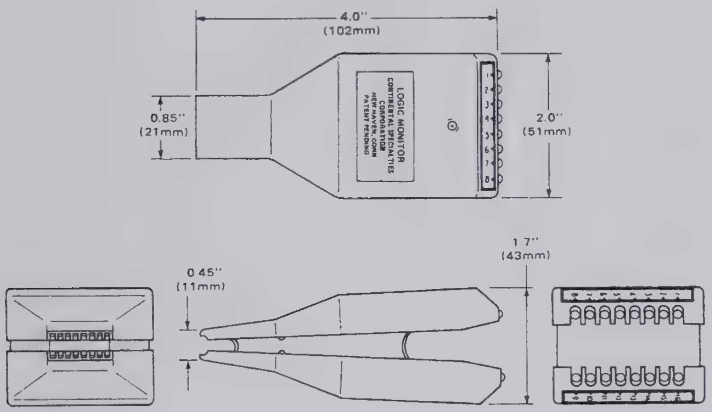


CURRENT DRAIN TEST CIRCUIT

SPECIFICATIONS

Input Threshold	2V ± 0.2 volts
Input Impedance	100,000 Ohms
Input Voltage Range	4 volts minimum 15 volts maximum across any two or more input leads.
Maximum Current Drain	200 ma @ 10 volts
Maximum Input Frequency*	10,000 Hz 50% duty cycle
Operating Temperature Range	0°C to 50°C
Weight	3 ounces (85 grams)
Maximum Dimensions	LxWxD 4.0x2.0x1.7" 102x51x38 mm

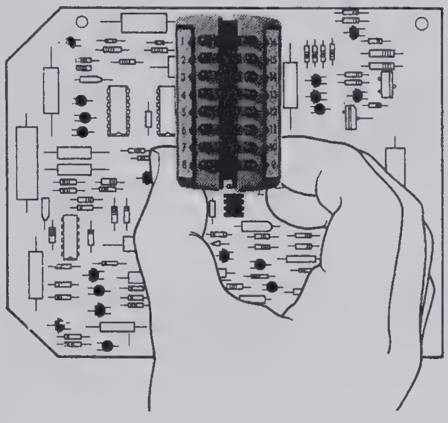
*LM-1 will respond to signals up to 0.1 MHZ when the input signal swing exceeds the threshold voltage by more than 0.5 volts.



USING YOUR LM-1

Simply squeeze the top end of the Logic Monitor so it will slip over the IC to be investigated. Once in place, the Logic Monitor does the rest. The Vcc or the most positive IC terminal will be indicated by a continuously lighted LED. The least positive; uncommitted and Logic 0 IC terminals will appear as unlighted LEDs.

By reducing the system or IC input signal rate to 10 Hz or less, you will be able to see each Logic state of the IC under investigation. Trouble shooting with the Logic Monitor requires a knowledge of the IC logic pin outs. For example: Consider a quad and gate configuration. If the output pin of one of the gates is constantly low (LED off) and the gate inputs are not simultaneously high, either the gate output is shorted to ground internally or a short exists on the lines fed by the gate output.



WARNING

Do not connect LM-1 to any IC that has more than 15V across any two pins. The LM-1 is a two level monitoring device. ICs with three supplies, -12, ground and +5V, are **NOT** compatible with the LM-1.

CONTINENTAL ● SPECIALTIES

logic monitor

WHAT IT DOES

CSC's Logic Monitor, LM-1, simultaneously displays the static and dynamic logic states of DTL, TTL, HTL or CMOS 14-pin and 16-pin digital DIP ICs.

HOW IT WORKS

The voltage at each IC lead is measured by one of 16 independent binary/optical voltmeters. When one of the input voltages exceeds the 2 volt threshold the LED corresponding to the activated input pin is turned on. Inputs below the threshold or uncommitted (floating) do not activate their corresponding LEDs. A built-in power seeking gating network locates the most positive and negative voltages applied to the IC under test. It then feeds them to the internal buffered amplifiers and LED drivers.

HOW IT IS USED

Just clip the LM-1 to any digital IC up to 16 pins. Precision plastic guides and flexible plastic web* insure positive connections between nickel silver contacts and IC leads. Static and dynamic logic levels appear instantly on 16 (.125" diameter) LEDs.

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*Patent Pending

PRICE $2.00

Assembling and Using your

CONAR

Tube Tester

Model 223

QUALITY EQUIPMENT BUILT ON A HALF CENTURY OF SERVICE IN ELECTRONICS

Dear Customer

No matter what your experience has been with equipment, there's a new and even greater satisfaction awaiting you in this CONAR product.

CONAR is a division of the National Radio Institute - a pioneer of more than 50 years in the Electronics field. True, age alone is seldom a compliment. Yet there is no substitute for the priceless ingredient of experience. Intelligent design and engineering, clear-cut instructions written for the user, top-grade components are your assurance you have made a wise choice - a sound dollar investment.

The purpose of this book is to tell you how to get maximum value from this CONAR product. Please read these instructions carefully and follow them faithfully. Then you can rely on the dependable service of CONAR quality.

We reserve the right to make changes in design or improvement when such changes or improvements represent an equal or greater value to our customers.

WARRANTY

All CONAR products are guaranteed against factory defects for ONE FULL YEAR. Any part or component that becomes defective and such defect is not the result of accidental damage, improper use or wiring errors, will be replaced when returned to CONAR.

There are four conditions under which you may have to write us about this CONAR product:

(1) It arrives damaged. We ship some items by parcel post, others by express. In a parcel post shipment, if any part is broken on arrival, we will replace it without charge, if you return it to us. However, for damage in express shipments, the Railway Express Agency is responsible. If you find any damage in an express shipment, contact the Express Agency and ask for an Inspection Report. They will fill out the report and give you a copy, which you are to send to us. We cannot replace damaged parts until we receive this report.

(2) Parts are missing. If anything is missing, and you find no substitute or other instructions after carefully examining the packing for small items, write us a letter explaining.

(3) A part has a defect. DEFECTIVE MATERIAL MUST BE RETURNED BEFORE A REPLACEMENT CAN BE MADE. TWO THINGS MUST BE WITH EVERY PACKAGE YOU RETURN TO US: (1) Your name and address, (2) Your reason for returning it. You may enclose a letter in the package, if you mark the package "first class letter enclosed". Such a package requires a stamp in addition to the regular parcel post charge. Unless examination shows an obvious defect, write first, and tell us why you think the part is defective. Some other part may be causing the trouble.

(4) You lose or damage parts. Parts listed in this manual may be ordered directly from CONAR, 3939 Wisconsin Ave., Washington, D.C., 20016. When ordering parts, please be sure to give the following information:

1. The part number.
2. The part name.
3. The type and model number of the product in which the part is used.

CONAR INSTRUMENTS DIVISION OF NATIONAL RADIO INSTITUTE, WASHINGTON, D.C. 20016

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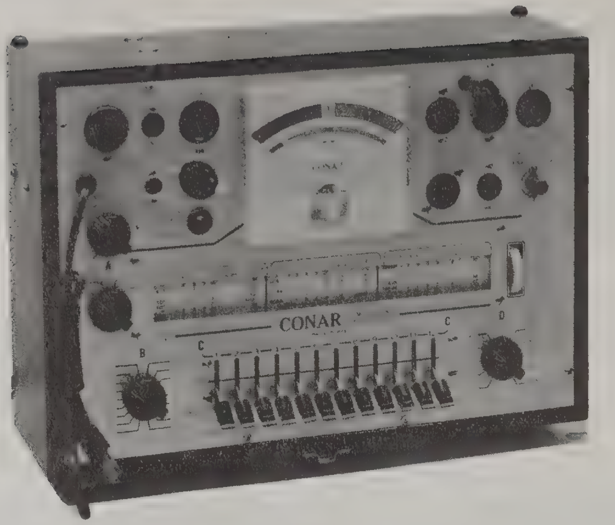
223-A-7100 1970 EDITION Litho in U.S.A.

The CONAR Model 223 Tube Tester



CONAR MODEL 223 TUBE TESTER

MODEL 223 FEATURES

ACCOMMODATES ALL SERIES STRING AND OTHER UP-TO-DATE TUBE TYPES: - 17 individual filament voltages from .75 to 110 volts. Tests all standard base types: 4-, 5-, 6-, 7-pin large, octal, loctal, 7-, 9-, and 10-pin miniature, and 5 pin nuvistor, novar and compactron.

OPEN ELEMENT TESTS: - This special test supplements the primary Emission Test.

12 LEVER ELEMENT SELECTOR-DISTRIBUTION SYSTEM: - This important CONAR feature provides complete flexibility and anti-obsolescence assurance due to new tube basing terminations.

THREE-COLUMN, TUBE ROLL CHART.

INDEPENDENT FILAMENT TERMINAL SELECTION: - Locates terminals of all filaments (single, double, center-tapped) regardless of pin positions. This is possible only when 12 instead of the usual 10 levers are provided.

FILAMENT CONTINUITY TESTS: - Rapidly shows up open filaments including open sections of tapped filaments.

TESTS SPECIAL TUBES: - Tests special-purpose tubes and gas rectifier types such as 0Y4, 0Z3, 0Z4 and remote-control gaseous types such as 0A4.

TESTS MULTI-SECTION TUBES: - Individual tests for each section of multi-section tubes (where required). Open-close "eye" tests of cathode ray indicator tubes.

HOT CATHODE LEAKAGE TESTS: - Reliable, sensitive neon method shows up cathode leakage.

INTER-ELEMENT SHORT TESTS: - Made universally simple through the use of the CONAR 12-lever element selector system.

METER: - Large, easy-to-read, clear-plastic cased meter. Rugged, double-jeweled D'Arsonval type.

LINE ADJUSTMENT: - Read directly on meter. Continuously variable, heavy-duty line-voltage control.

TEST CIRCUITS COMPLETELY TRANSFORMER-ISOLATED FROM POWER LINE: - Assures utmost safety to operator and instrument.

SEPARATE WINDING ON POWER TRANSFORMER FOR TEST VOLTAGE. Filament voltage taps are NOT used for test voltage supply.

GENERAL KIT CONSTRUCTION INFORMATION

The CONAR kit you have just purchased is a high quality instrument. When assembled and used as described in this manual, it will provide many years of trouble-free service. Therefore, if you work carefully and patiently, you will have more satisfaction with your new instrument and greater confidence in your ability.

MANUAL

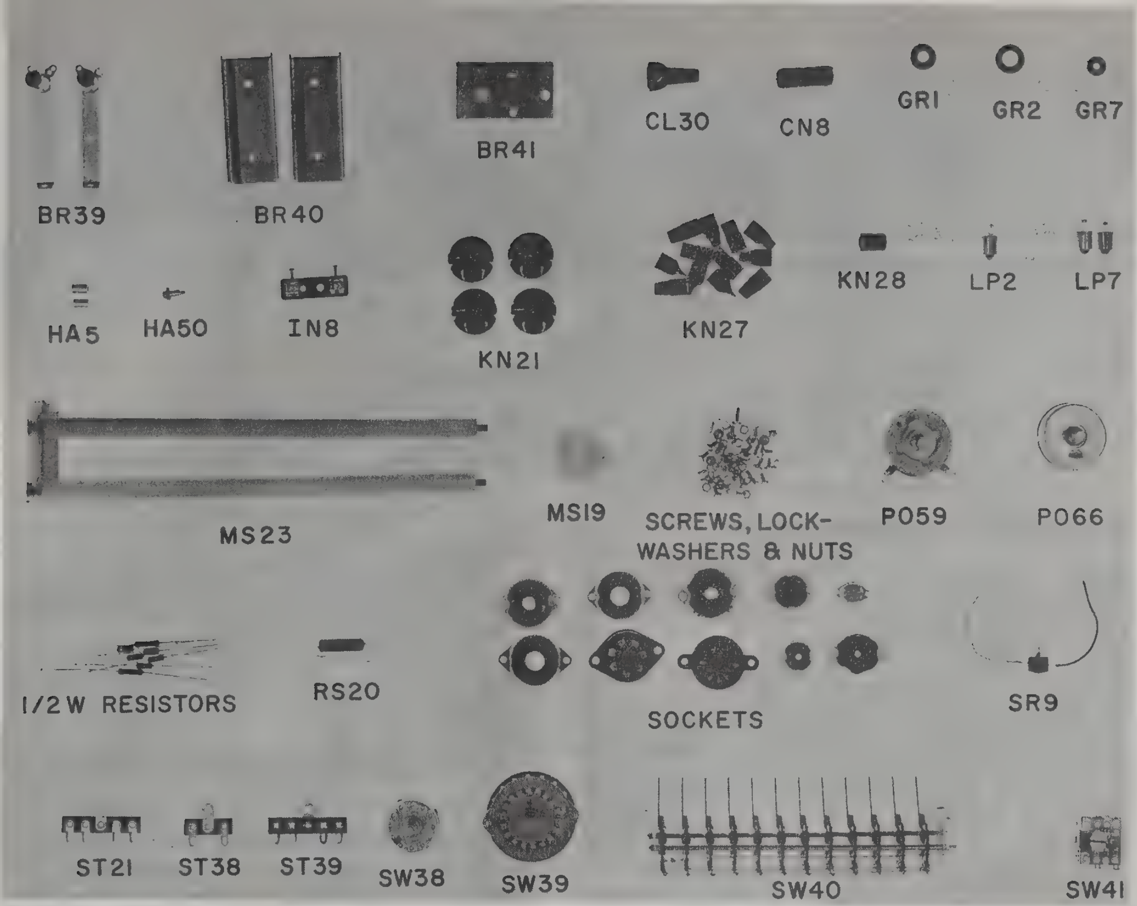
We suggest that you spend a little time NOW and read the manual thoroughly before starting the actual construction of the kit. This will familiarize you with the parts used and the general procedure to be followed.

The step-by-step instructions will help you assemble the instrument with a minimum possibility of error.

Keep this manual for ready reference in the use and maintenance of your CONAR instrument.

UNPACKING

Be careful as you unpack the kit. Parts may become damaged through carelessness. Do not throw away any packing materials until you account for all parts. Check the parts against those shown in Fig. 1 and listed under the photo. In some cases we may substitute parts of slightly different physical appearance but with the specified electrical characteristics. For example, a .05-mfd capacitor may be substituted where a .047-mfd capacitor is called for in the parts list. Such a substitution has been checked carefully and will work satisfactorily. After checking the parts against the parts list, put them where they won't get lost or



Quan.	Part No.	Description	Price Each
2	BR39	Pilot lamp bracket	.30
2	BR40	Transformer mtg. bracket	.20
1	BR41	Roll chart mtg. bracket	.15
1	CB21	Cabinet**	8.25
1	CL30	Top cap	.23
5	CL31	Wedge-lock band cable clamp**	.08
3	CL32	Etho-lock clamp**	12/.25
1	CN8	.05 mfd capacitor	.15
1	FU6	Fuse**	.22
1	GR1	3/8" grommet	12/.25
1	GR2	1/2" grommet	.05
1	GR7	5/16" grommet	.06
2	HA5	3/8" spacer	.08
1	HA13	solder**	.64
1	HA50	Spacer bushing	.30
1	IN8	Fuse holder	.15
2	IN20	3" piece spaghetti**	.18
4	KN21	Pointer knob	.15
12	KN27	Push-on knob for lever switch	.08
1	KN28	Push-on knob for push-to read switch	.08
1	LP2	Neon bulb	.35
2	LP7	Pilot lamp	.12
1	ME15	Meter**	9.50
1	MS15	Roll chart window**	.35
1	MS19	Thumb wheel	.50
1	MS22	*Masking tape**	.10
1	MS23	Roll chart assembly	2.67
1	MS39	Roll chart**	.66
20	NU1	6-32 nut	12/.15
4	NU3	8-32 nut	12/.15
6	NU5	4-40 nut	12/.15
2	NU8	2-56 nut	12/.15
1	PA28	Panel**	3.52
1	PC1	Power cord**	.40
1	PO59	300-ohm pot., 25W	3.77
1	PO66	300-ohm pot., 3W	1.37
1	RE28	470-ohm resistor	.15
1	RE30	1K-ohm resistor	.15
1	RE60	680K-ohm resistor	.15
1	RE96	60K-ohm resistor, 1%	.78
1	RE110	1.8K-ohm resistor	.15
1	RE137	5.1K-ohm resistor, 5%	.24
1	RE138	51-ohm resistor, 5%	.24
1	RE151	348-ohm resistor, 1%	.78
1	RS20	2.5K-ohm resistor, 5W	.66
2	SC12	1/4" X 2-56 screw	12/.25
3	SC13	3/8" X 6-32 screw	12/.15
4	SC17	1-1/2" X 8-32 screw	12/.25
8	SC26	1/2" wood screw	12/.25
1	SC39	3/8" X 4-40 screw	12/.15
2	SC47	9/16" X 6-32 screw	12/.25
4	SC62	3/4" X 10-32 screw	6/.25
21	SC63	1/4" X 6-32 screw	12/.25
7	SC65	1/4" X 4-40 screw	12/.25
1	SO55	9-10 pin socket	.26
1	SO56	Bayonet socket**	.20
1	SO57	5-pin nuvistor socket	.26
1	SO58	Combination 4-5-6 prong socket	1.15
1	SO59	8-pin loctal socket	.51
1	SO60	9-pin novar socket	.15
1	SO62	7-pin miniature socket	.12
1	SO63	8-pin octal socket	.16
1	SO64	12-pin compactron socket	.24
1	SO65	7-pin (large) socket	.28
1	SO77	10-pin miniature socket	.20
1	SR9	Meter rectifier	1.29
1	ST21	4-lug terminal strip w/ins. mtg. foot	.10
1	ST38	2-lug terminal strip	.05
1	ST39	4-lug terminal strip	.09
1	SW38	2-pole, 4-pos. rotary switch (SWA)	1.12
1	SW39	17-position rotary switch (SWB)	2.10
1	SW40	12-gang lever switch (SWC)	6.24
1	SW41	DPDT spring return push-button switch (SWD)	.71
1	TR71	Power transformer**	13.34
4	WA14	3/8" washer	12/.15
27	WA15	No. 6 lockwasher	12/.15
4	WA16	No. 8 lockwasher	12/.15
2	WA20	No. 2 lockwasher	12/.15
1	WA21	No. 4 lockwasher	12/.15
4	WA22	Nickel-plated washer	12/.15
1	WA23	Spring washer**	12/.25
1	WR76	Bus wire**	***
1	WR224	White wire**	***
1	WR225	Green wire**	***
1	WR226	Yellow wire**	***
1	WR227	Brown wire**	***
1	WR228	Purple wire**	***
1	WR229	Orange wire**	***
1	WR230	Blue wire**	***
1	WR231	Black wire**	***
1	WR232	Red wire**	***
1	WR233	Orange/black wire**	.55
1	WR234	White/black wire**	.55
1	WR235	Yellow/black wire**	.29
1	WR236	Green/black wire**	.41
1	WR237	Black and white twisted wire**	.15
1	WR238	Grid cap lead**	.20

---

*Packed on back of panel. Remove before mounting sockets.

**Not shown.

***Additional wire is available in 12' lengths at .25.

damaged. The color code chart at the back of this manual will assist you in identifying resistors and capacitors. If any part seems to be missing, write us at once so that we can supply a replacement.

TOOLS REQUIRED FOR ASSEMBLY AND WIRING OF CONAR KITS

Only standard type tools are required in the construction of CONAR kits -- a good quality soldering iron (50 or 60 watts) with a small tip, a pair of long-nose pliers, a pair of side-cutting pliers, a small assortment of screwdrivers, and an inexpensive pair of wire strippers. Nut-drivers with a screwdriver handle may be used in place of wrenches in most cases.

ASSEMBLY AND WIRING

The position of wires and parts in this instrument is critical in some cases, and changes may affect the operation. Follow the diagrams closely and you should encounter little, if any, difficulty because the layout has been thoroughly checked and tested for best results.

When wiring, remove only about 1/4" of insulation from the ends of hookup wire. Removing any excessive amount of insulation may result in the exposed wire shorting to nearby terminals or wiring. Leads on parts (resistors, capacitors, etc.) should be trimmed to proper length after mounting. Do not cut leads too short! All parts should fit between mounting points without strain.

SOLDERING

To obtain satisfactory performance, good solder joints are essential. Read and follow the enclosed instructions on soldering. Read this sheet NOW.

SERVICE POLICY

CONAR Instruments Div., Inc., offers its full cooperation and assistance to help you obtain the specified performance from your instrument. We maintain a complete Consultation Service with which you may correspond if you experience difficulties with your complete instrument. We will inspect and repair this TUBE TESTER for a minimum service charge of $5 plus cost of parts, provided it has been constructed and completed according to instructions in this manual. This special repair service is available for one year from purchase date. Repair service for CONAR instruments that have been used longer will be available for CONAR owners at most economical charges.

Instruments that have been modified in design will not be accepted for repair. Instruments showing evidence of the use of ACID CORE SOLDER or PASTE FLUXES will be returned not repaired.

Instruments for repair or service MUST be returned to us, transportation charges PRE-PAID, according to the following shipping instructions.

SHIPPING INSTRUCTIONS

When returning this instrument, be sure the power transformer is securely mounted as described in this manual. Always pack instruments carefully in a rugged, OVERSIZED container, preferably wood, using a generous supply of padding such as excelsior, shredded paper, or crumpled newspaper. You can ship in the original kit carton. Attach a tag to the instrument giving your name, address, and trouble experienced. Never return an instrument unless it is accompanied by a full explanation of difficulties encountered.

Please ship Via Railway Express PREPAID and address to:

CONAR
3939 WISCONSIN AVENUE
WASHINGTON, D.C. 20016

A FRAGILE label should appear on at least four sides of the carton.

Return shipment by CONAR will be by Railway Express COLLECT, including repair service charges, unless otherwise requested.

Please note that a carrier cannot be held liable for damage in transit if, in HIS OPINION, packing is insufficient!

STEP-BY-STEP ASSEMBLY

These instructions were prepared from experience in actually constructing this CONAR kit. You will find them arranged in a logical sequence, with every consideration given to the practical aspects of kit assembly. We feel the instructions offer the fastest and best method of assembling your CONAR kit. DO NOT build from the schematic even though you are thoroughly familiar with such diagrams.

Read each step thoroughly and understand the step completely before performing it. This will help you avoid errors. As you complete each step, put a check mark in the parentheses at the end of the line.

Some of the wiring instructions are given in the form of tables. These tell you which part or wire is to be connected, and the connection point or points, and which connections, if any, are to be soldered at that time. If other connections are to be made to the same point, you will usually be told not to solder the connection until later. In that case, just crimp the lead to the terminal and proceed to the next step. This will help avoid omissions.

To aid you in placing components, a system of alphabetical and numerical coding has been devised. Switches have been coded with a letter designation of "SW." Because there is more than one component of this type, distinction is made by added letters. For example, "SWA" indicates one switch, and "SWB" indicates a second switch, etc. All controls and resistors have been coded with an "R" designation followed by a number (R1, R2, etc.). All capacitors have been coded with a "C" designation followed by a number (C1, etc.). These designations appear on the schematic, in the parts list, and in step-by-step instructions and wiring diagrams.

Other items, such as ground lugs, grommets, and terminal strips, have been assigned letter designations having no particular reference to function.

Numbers have been assigned to terminals on the various components. Thus, "SWA2" indicates terminal 2 of switch "SWA," "SWB3" indicates terminal 3 of switch "SWB," etc. The terminals on the controls are referred to as terminal No. 1 of R1, terminal No. 3 of R2, etc.

The assembly is divided into 4 stages. First the main mechanical components are mounted. The next stage involves wiring the tester circuits with the exception of the power transformer. In the third stage the power transformer is mounted in the case and its leads connected. Finally, the various knobs are attached to the shafts passing through the front panel.

You are ready to build your CONAR TUBE TESTER.

Mechanical Assembly

There are three sizes of screws and nuts, and two sizes of lockwashers used in mounting parts on the panel. The screw sizes are 6-32, 4-40, and 2-56. The 6-32 is the largest diameter screw and the 2-56 the smallest. The nuts fit the screws for which they were designed. The No. 6 lockwashers are used for both the 6-32 and 4-40 screws, while No. 2 lockwashers are used for the 2-56 screws. Use lockwashers and nuts on all screws. Unless otherwise stated, the lockwashers are always directly under the nuts. All sockets except the nuvistor socket shown in Fig. 2 as E are mounted on the back of the panel. The base of the nuvistor socket protrudes through the panel to the back but its saddle mount is on the front of the panel.

The proper method used in mounting a socket on the back of the panel is shown in Fig. 3. The screws are passed through from the front (printed side) of the panel, through the socket mounting holes, through lockwashers and into the nuts which are then tightened.

Place a soft cloth or pad on the workbench to avoid scratching the panel finish while you are constructing the tube tester.

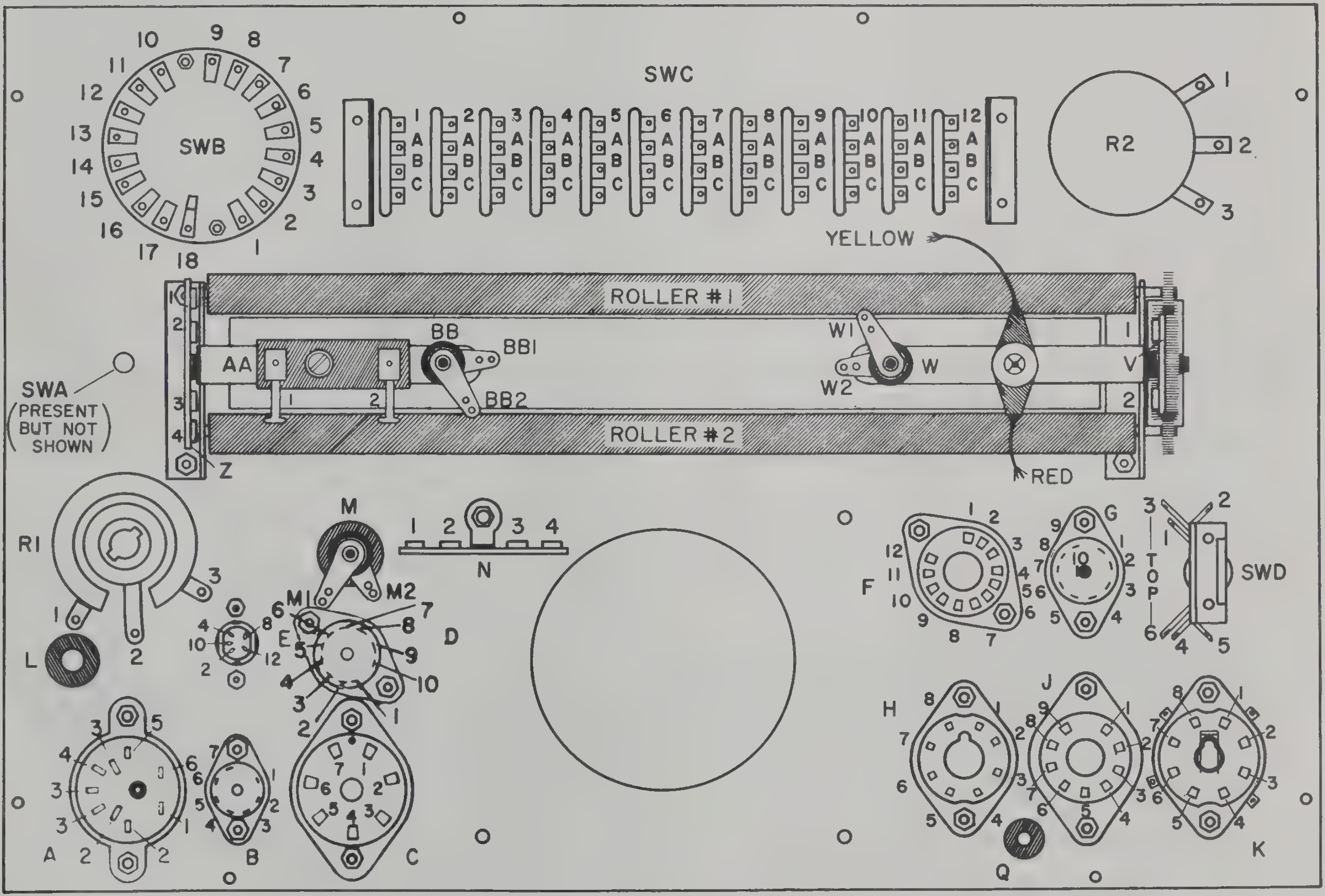


FIG. 2. Back of panel showing parts location in mechanical assembly.

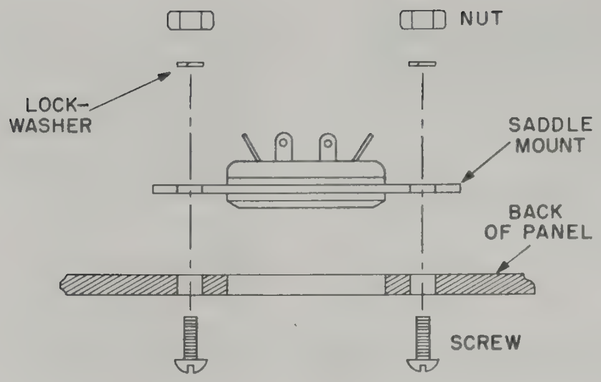


FIG. 3. Mounting a socket on the back of the panel.

MOUNTING THE PARTS ON THE PANEL

Mount the four, five and six pin combination socket on the back of the panel at A, as shown in Fig. 2. Be sure the socket is positioned as shown in Fig. 2. Use the 3/8" × 6-32 screws which are long enough to fit through the panel and the Bakelite ears of the socket. For this socket draw the nuts up firmly but not too tight, because excess pressure could break the socket ears..( )

In a similar manner, mount the seven-pin miniature socket, positioning at B as shown in Fig. 2. Use 1/4" × 4-40 screws ....( )

Mount the large seven-pin socket at C, positioning as in Fig. 2. Use 1/4" × 6-32 screws..................( )

Place the 5-pin nuvistor socket on front of the panel so the body and lugs protrude through to the back. Position carefully as shown at E and mount with 1/4" × 2-56 screws. Do not overtighten screws as threads may strip. Bend out all socket lugs. This facilitates wiring ....( )

Mount the 10-pin socket (no terminal in center) in the same manner as the 7-pin socket, positioning as shown at D. Use 1/4" × 4-40 screws ....( )

Mount the 12-pin compactron socket in position F as shown. Use 1/4" × 6-32 screws ....( )

Mount the 9-10-pin miniature combination (10th center pin) socket at G, positioning as shown. Use 1/4" × 4-40 screws ....( )

Mount the 8-pin octal socket in the position shown at H in Fig. 2. Use 1/4" × 6-32 screws ....( )

Mount the 9-pin novar socket in the position shown at J in Fig. 2. Use 1/4" × 6-32 screws ....( )

Mount the 8-pin loctal socket in the position shown at K in Fig. 2. Bend out the 4 grounding lugs until they are against the panel. Use 1/4" × 6-32 screws ....( )

There are three rubber grommets of different diameters which are to be mounted in the panel. They are at positions L, M and Q in Fig. 2. By comparing the hole size and the grommet size, you will have no trouble in choosing the right grommet for each hole. To install a grommet, you grasp it between your thumb and forefinger and press so that the grommet is slightly egg-shaped. Put one end into the hole so the rubber is on both the top and bottom of the panel. Gradually work the entire grommet into the hole so that the edge of the hole is lined with rubber.

Install the medium sized grommet in hole L as shown in Fig. 2 ....( )

Install the largest grommet in hole M in Fig. 2...( )

Install the smallest grommet in hole Q as shown in Fig. 2 ....( )

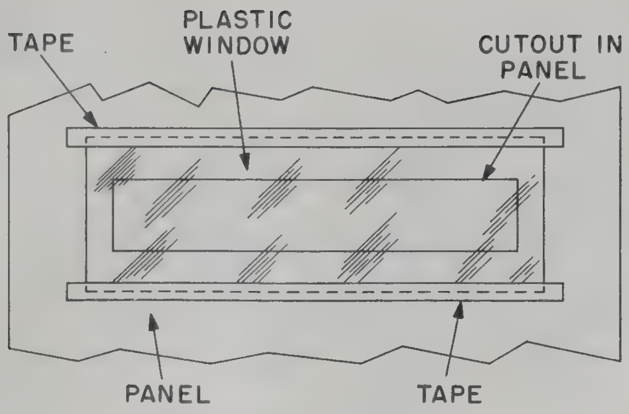


FIG. 4. Attaching plastic window to panel.

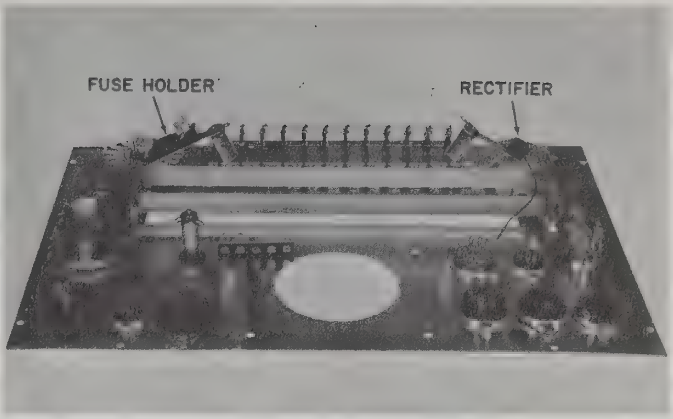


FIG. 5. Position of meter rectifier and fuse holder.

Install the transparent window for the roll chart on the back of the panel using two 10-inch pieces of masking tape. Place tape on the plastic window with the overlap directly against the metal surface, as shown in Fig. 4.. ( )

Temporarily mount 4-lug terminal strip N on the panel as shown in Fig. 2. Use a 1/4" × 6-32 screw and nut; no lockwasher is required. Later the nut and screw will be removed as a meter stud will hold the terminal strip in place. The other terminal strips with flat feet are to be mounted later......................( )

Mount the meter rectifier on one pilot lamp bracket positioning the rectifier as shown in Fig. 2 and 5. Use a 6-32 nut. Do not pull on or move the leads more than necessary as they are fragile and can be broken off the rectifier..( )

Mount the fuse holder on the other pilot lamp bracket as shown in Figs. 2 and 5. Use a 3/8" × 6-32 screw..( )

Mount a 2-lug terminal strip and the rectifier pilot lamp bracket on the geared roll chart bracket as shown in Fig. 2. Use a 1/4" × 6-32 screw..( )

Mount a 4-lug terminal strip and the fuse holder pilot lamp bracket on the other roll chart bracket as shown in Fig. 2. Use a 1/4"×6-32 screw.. ( )

Mount the geared roll chart bracket on the back of the panel as shown in Figs. 2 and 5. Use two 1/4" × 6-32 screws... ( )

Now attach the spacer bushing, thumb wheel, spring washer, lockwasher, and 3/8" × 4-40 screw to the bracket as shown in Fig. 6..( )

Mount the other roll chart bracket on the back of the panel as shown in Figs. 2 and 5. Be sure and slip the studs of the wooden dowels into the holes of the bracket before it is fastened to the panel. Use two 1/4" × 6-32 screws... ( )

To install the roll chart, position the panel as shown in Fig. 7. The chart is rolled so the top lines of the chart unroll first and the tube test data is printed on the outside of the roll.. ( )

Unroll about 7 inches of the chart and insert this end under roller No. 1. Slide the chart along the window under and up in front of roller No. 2. The end of the chart should be centered on the wood roller to give equal clearance between the edges of the paper and the mounting brackets. Attach this end of the chart to roller No. 2 with a 7-inch piece of masking tape...( )

Turn the gear wheel so the chart winds up on roller No. 2.. ( )

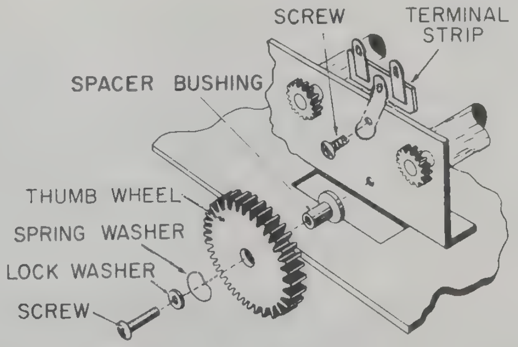


FIG. 6. Attaching the spacer bushing, thumb wheel, lockwasher and screw to geared roll chart bracket.

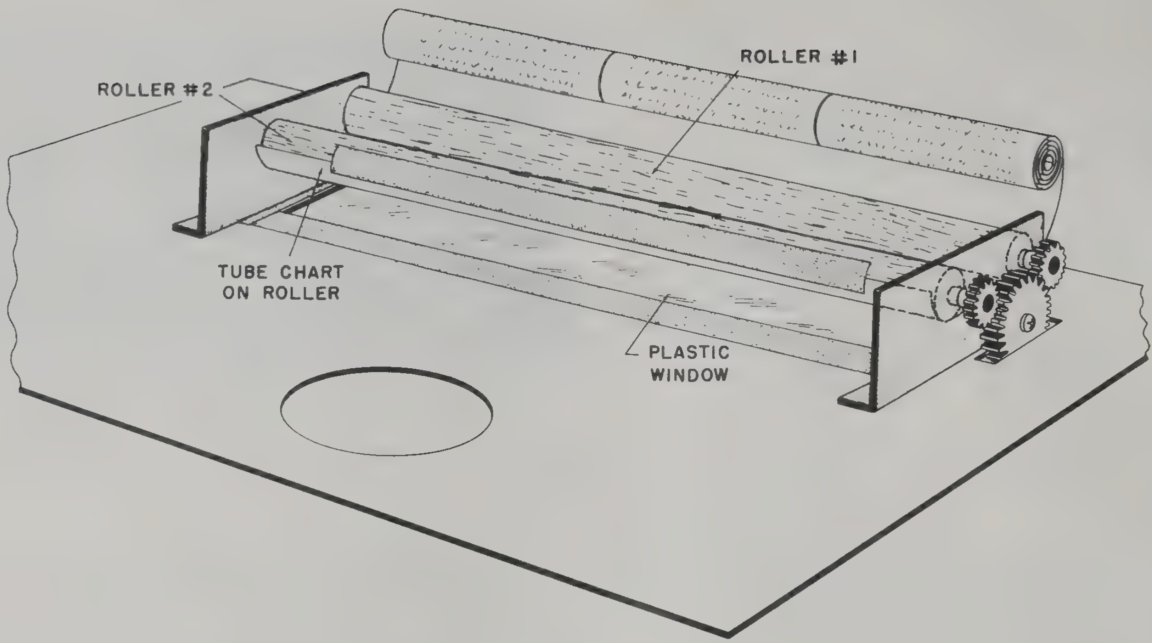


FIG. 7. Installing the roll chart.

When the other end of the chart is reached, check the paper on roller No. 2. If it appears to be too loose, re-roll the paper on the roller more tightly. The loose end of the chart is attached to roller No. 1 with a 7-inch piece of masking tape. This end will not necessarily match up with the small groove in roller No. 1 but should be parallel to it. The chart should roll smoothly from one end to the other. If the paper is too loose, there will be excessive play; if it is too tight, the chart will bind.

Slip a piece of paper (a cut-up paper bag will do) around the chart and tie in place with a piece of string or Scotch tape. This will protect the roll chart from solder and rosin splatters. It is to be removed before the panel is attached to the cabinet..( )

Before installing switch SWA, mount the parts on the switch. You will need:
One 5.1K-ohm resistor (green, brown, red)
One 1K-ohm resistor (brown, black, red)
One 2.5K-ohm resistor, 5 watt
One 1.8K-ohm resistor (brown, gray, red)
One 470-ohm resistor (yellow, violet, brown)
One 16-1/4" red wire
One 15" red wire
One 2-1/2" red wire
One 2-1/2" black wire

The locations of the resistors and wires are shown in Fig. 8. The switch lugs are in the position shown when the locating tab on the front of the switch appears as in Fig. 8. Note that the lead of the 1.8K-ohm resistor passes through lug 9 and then through lug 10. The bodies of all resistors are quite close to the lugs on the switch. Place all parts and leads in place and solder all lugs. Do not cut the free leads of any of the resistors...( )

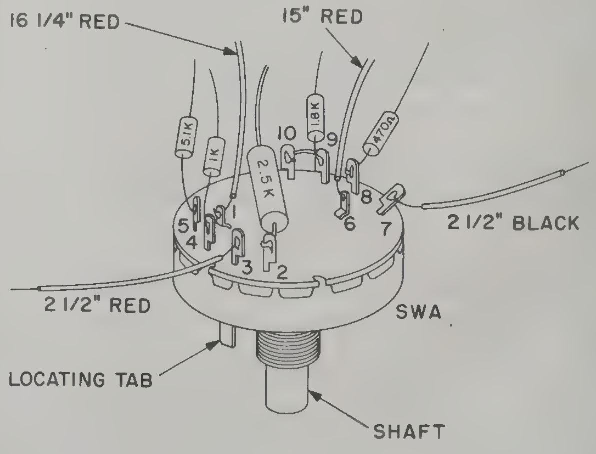


FIG. 8. Resistors and wires on switch SWA.

Now mount the switch on the back of the panel in the position indicated in Fig. 2. The locating tab must pass through the corresponding panel hole. Use a flat washer and nut on the front of the panel to fasten SWA in place..( )

Pass the free lead of the 5.1K-ohm resistor through terminal Z1 and crimp; cut off excess lead..........( )

Pass the free lead of the 1K-ohm resistor through Z1 and crimp in place, cutting off the excess lead length..........( )

Pass the free end of the 2-1/2" red wire through Z1 and crimp. Do not solder..........( )

Pass the free lead of the 2.5K-ohm resistor through Z2 and crimp. Do not solder Z2..........( )

Pass the free lead of the 1.8K-ohm resistor through Z3 and crimp. Do not solder ....( )

Pass the free end of the 2-1/2" black wire through Z3. Crimp but do not solder..........( )

Attach the free lead of the 470-ohm resistor to Z3. Crimp but do not solder..........( )

Run the two leads from 1 and 6 of SWA between the tube chart and sockets toward SWD. They will be fastened to the correct terminals later..........( )

Install potentiometer R1 on the back of the panel as shown in Fig. 2. Use the same procedure as employed for SWA..........( )

Mount switch SWB on the back of the panel using the same procedure as employed for SWA..........( )

Position the 12-lever switch, SWC, on the back of the panel, as shown in Fig. 2. The mounting holes on the switch are threaded and no lockwashers or nuts are used. Attach with 1/4" × 6-32 screws..........( )

Mount potentiometer R2 on the back of the panel as shown in Fig. 9. In this case, place a lockwasher over the bushing of the potentiometer and then slide its shaft through the hole in the panel. Attach a flat washer and a nut on the front of the panel. Hold the potentiometer in the position shown in Fig. 2 and tighten the nut..........( )

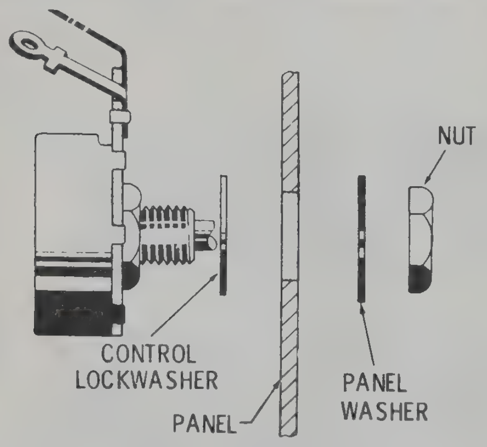


FIG. 9. Attaching potentiometer to panel.

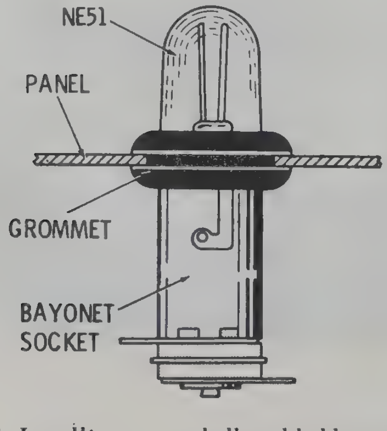


FIG. 11. Installing a neon bulb and holder on panel.

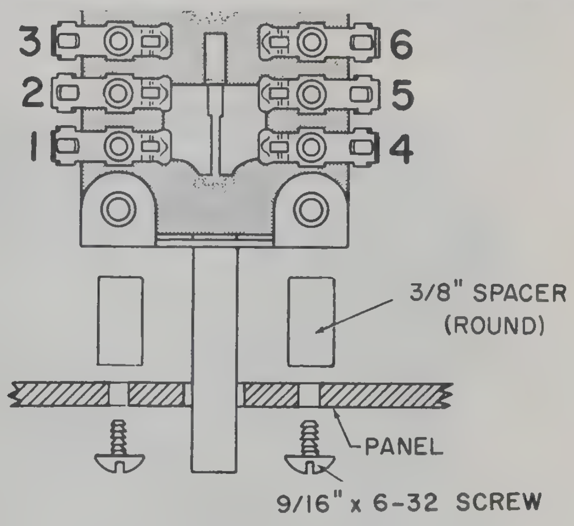


FIG. 10. Mounting SWD to panel.

Using two 3/8" spacers and two 9/16"×6-32 screws, mount switch SWD on the back of the panel, as shown in Fig. 2. Refer to Fig. 10 for mounting details.......( )

Insert the neon lamp in its holder and push it into the panel grommet at M, as shown in Fig. 2. Refer to Fig. 11 for details..........( )

This completes mounting the hardware on the front panel and your instrument should appear as shown in Fig. 2 with the exception of the paper on the chart and the parts on SWA.

WIRING THE SOCKETS

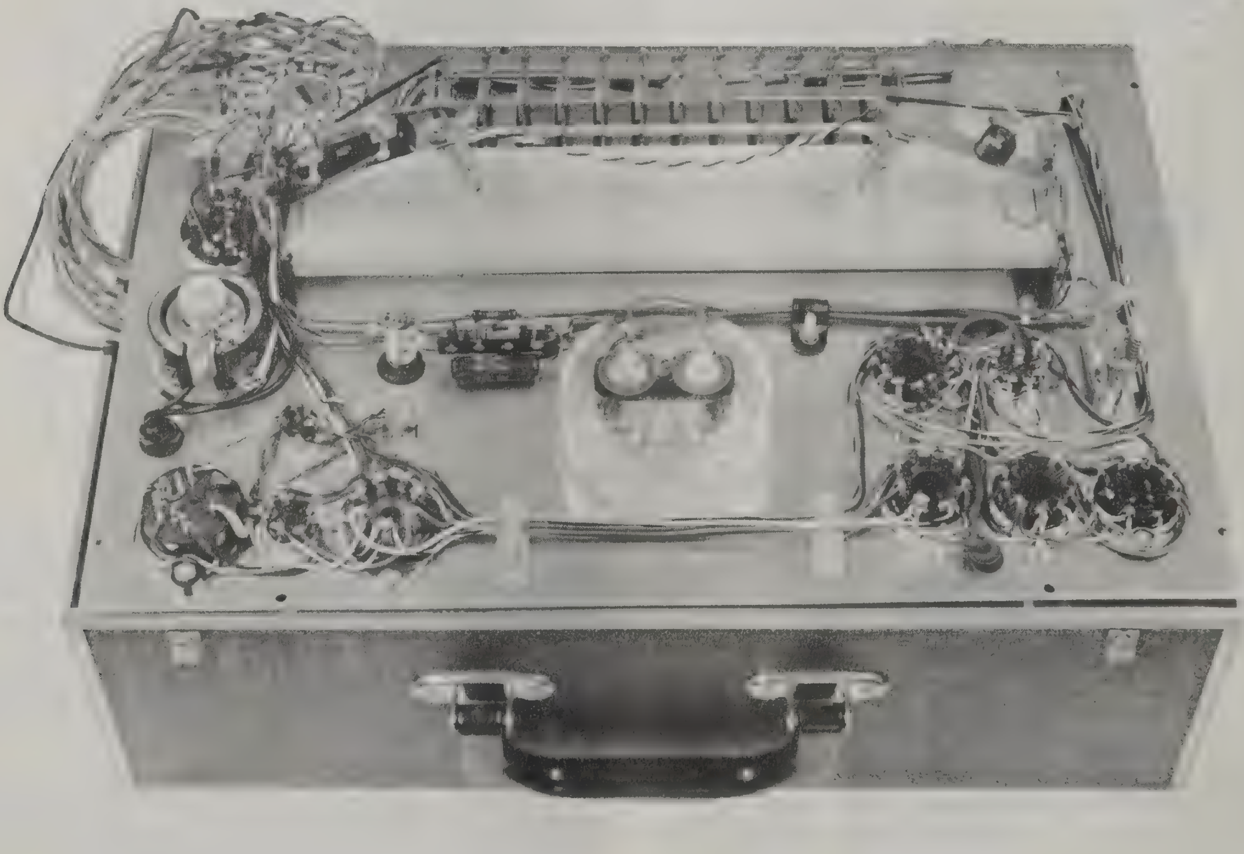
All socket pins having the same numbers will be wired together. Note that there are two groups of sockets divided between the left and right hand sides of the panel.

On the left, there is a combination socket, a nuvistor socket, a 7-pin miniature socket, a large 7-pin socket, and a 10-pin miniature socket. On the nuvistor socket the lead of lug 12, as described, runs across to the right-hand group, along with leads of lugs 8, 9, and 10 of the 10-pin miniature socket. Lugs 10 and 8 of the nuvistor socket will be connected to the 10-pin miniature socket.

When all lugs numbered 1 through 7 are connected together we will take seven leads from the corresponding lugs of socket D and route them between switch SWA and the roll chart mounting bracket, around the bracket of SWC and to the equivalent terminals on SWC. Leads from lugs 8, 9, 10, 11, and 12 of the right hand group of sockets will be routed between the edge of the chassis, SWD and R2, and connect the corresponding terminals on SWC.

We have not given a pictorial of a complete socket wiring because so many leads pass over each other that they could not be identified on a drawing; instead, separate pictorials are given for the various terminals. Instructions for wiring are given in Tables 1 through 11. The second column tells you the color and length of wire to use; the fourth column tells you where to connect it; and the fifth column what to solder. Cut all wires to proper length and strip 1/4" of insulation from each end before starting to install the wiring shown in each table. The accompanying pictorials make wire placement (dress) easy. Solder only when you are told to do so, because some terminals are to have several wires connected to them. Notice there are two "check" columns. Put a check mark in the first column after each step, as soon as you finish it. Then, when you have finished the assembly, go back and recheck each step. Be sure to follow the instructions exactly.

It is extremely important to use the correct colors of wires. Since there are so many wires, it is almost impossible to trace and check the connections of a wire which is not properly color-coded. To install a wire, bend a hook in the bare end, insert the hook in the hole in the lug specified, pinch the hook shut with your long-nosed pliers and connect the other end of the wire to its connection point. Cut off any excess wire and dress the lead as shown in the pictorial. In some cases you will be instructed to solder joints immediately; in others, you will not solder until later because other leads will be added to the same terminal. It is especially important to pinch the hook tight if the lug is not to be soldered until later. Be careful, however, in pinching the wire that you do not break it. A broken wire must, of course, be replaced.



The CONAR Model 223 showing the socket wiring.

TABLE 1

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	White 10"	12	1 SWC - 1D	1 SWC		
2	White 5"	12	1D - 1A	1D		
3	White 3"	12	1A - 1B	1A		
4	White 2-3/4"	12	1B - 1C	1B		
5	White 8-1/4"	12	1C - 1H	1C		
6	White 3-3/4"	12	1H - 1F	1H		
7	White 2-1/2"	12	1F - 1G	1F		
8	White 3-1/4"	12	1G - 1K	1G		
9	White 2-1/2"	12	1K - 1J	1K-1J		

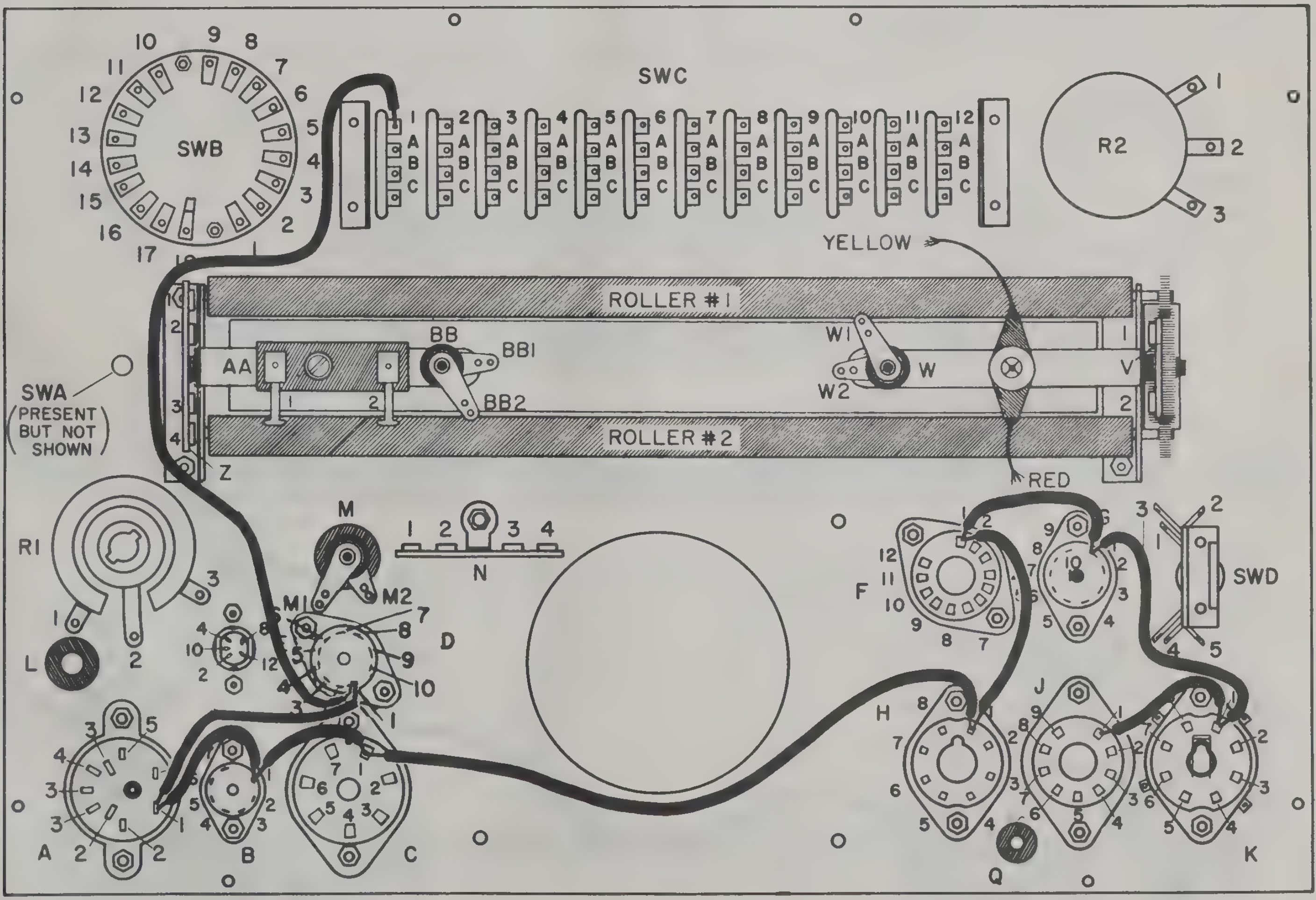


FIG. 12. Pictorial of wiring in Table 1.

TABLE 2

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Orange/black 11-1/4"	13	2SWC - 2D	2SWC		
2	Orange/black 5-3/4"	13	2D - both of 2A*	2D left 2A		
3	Orange/black 4"	13	Right 2A - 2E	2E		
4	Orange/black 3"	13	Right 2A - 2B	Right 2A		
5	Orange/black 3-1/4"	13	2B - 2C	2B		
6	Orange/black 8-3/4"	13	2C - 2H	2C		
7	Orange/black 3-1/2"	13	2H - 2F	2H		
8	Orange/black 3"	13	2F - 2G	2F		
9	Orange/black 3-1/4"	13	2G - 2K	2G		
10	Orange/black 3-1/4"	13	2K - 2J	2K - 2J		

*There are two No. 2 lugs on socket A.

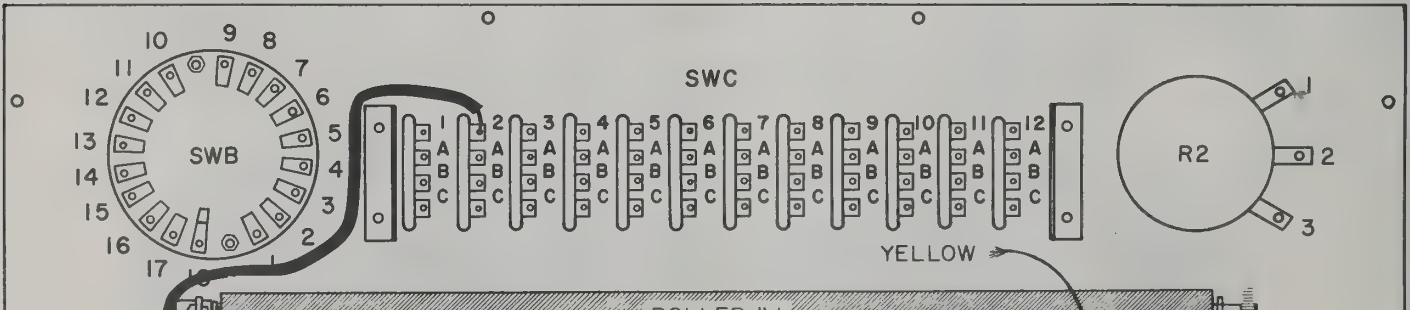


FIG. 13. Pictorial of wiring in Table 2.

TABLE 3

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Green 11-1/2"	14	3 SWC - 3D	3 SWC		
2	Green 4-1/2" (strip 1" at one end)	14	3D - three No. 3 pins of A	3D		
3	Green 3-1/2"	14	3A - 3B	All No. 3 of A		
4	Green 2-3/4"	14	3B - 3C	3B		
5	Green 8-1/4"	14	3C - 3H	3C		
6	Green 3-3/4"	14	3H - 3F	3H		
7	Green 3"	14	3F - 3G	3F		
8	Green 4"	14	3G - 3K	3G		
9	Green 3"	14	3K - 3J	3K - 3J		

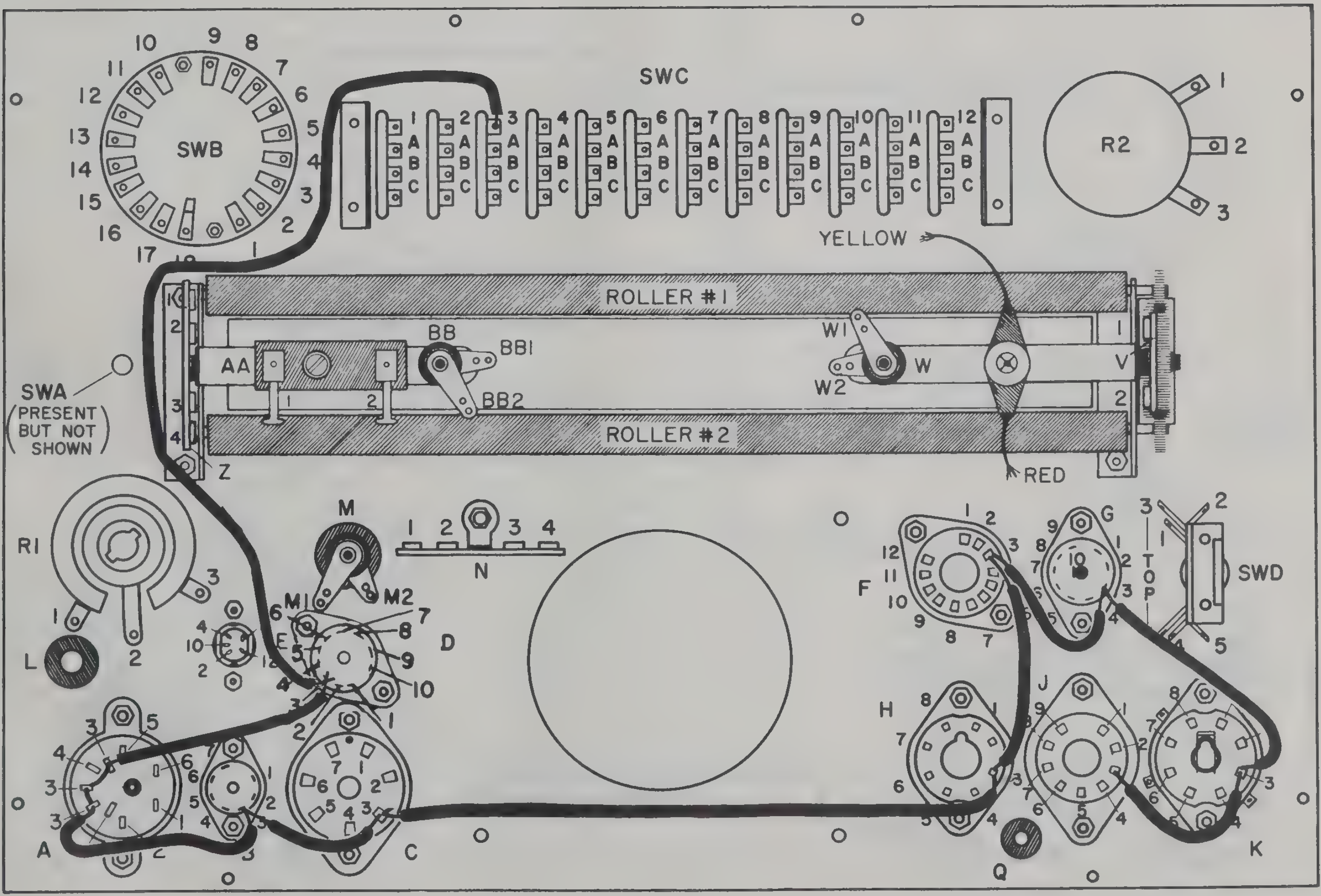


FIG. 14. Pictorial of wiring in Table 3.

TABLE 4

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	White/black 12"	15	4 SWC - 4D	4 SWC		
2	White/black 4-1/2"	15	4D - 4A	4D		
3	White/black 3-1/2"	15	4A - 4E	4E		
4	White/black 4-1/2"	15	4A - 4B	4A		
5	White/black 2-1/2"	15	4B - 4C	4B		
6	White/black 8-1/4"	15	4C - 4H	4C		
7	White/black 3-3/4"	15	4H - 4F	4H		
8	White/black 1-3/4"	15	4F - 4G	4F		
9	White/black 3-1/2"	15	4G - 4J	4G		
10	White/black 2-1/4"	15	4J - 4K	4J - 4K		

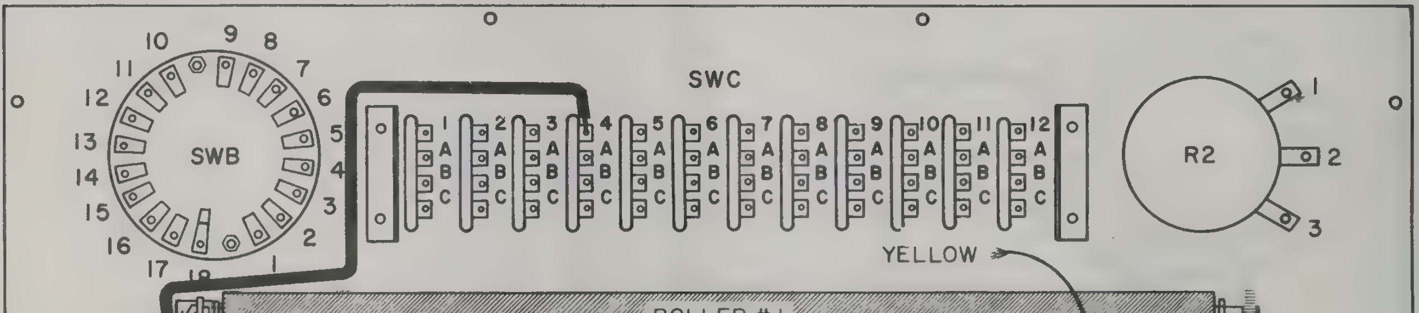


FIG. 15. Pictorial of wiring in Table 4.

TABLE 5

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Yellow 12-1/2"	16	5 SWC - 5D	5 SWC		
2	Yellow 4"	16	5D - 5A	5D		
3	Yellow 2-1/2"	16	5A - 5B	5A		
4	Yellow 2-3/4"	16	5B - 5C	5B		
5	Yellow 8-1/2"	16	5C - 5H	5C		
6	Yellow 2-3/4"	16	5H - 5J	5H		
7	Yellow 2-1/4"	16	5J - 5K	5J		
8	Yellow 3-1/4"	16	5K- 5G	5K		
9	Yellow 1-1/2"	16	5G - 5F	5G - 5F		

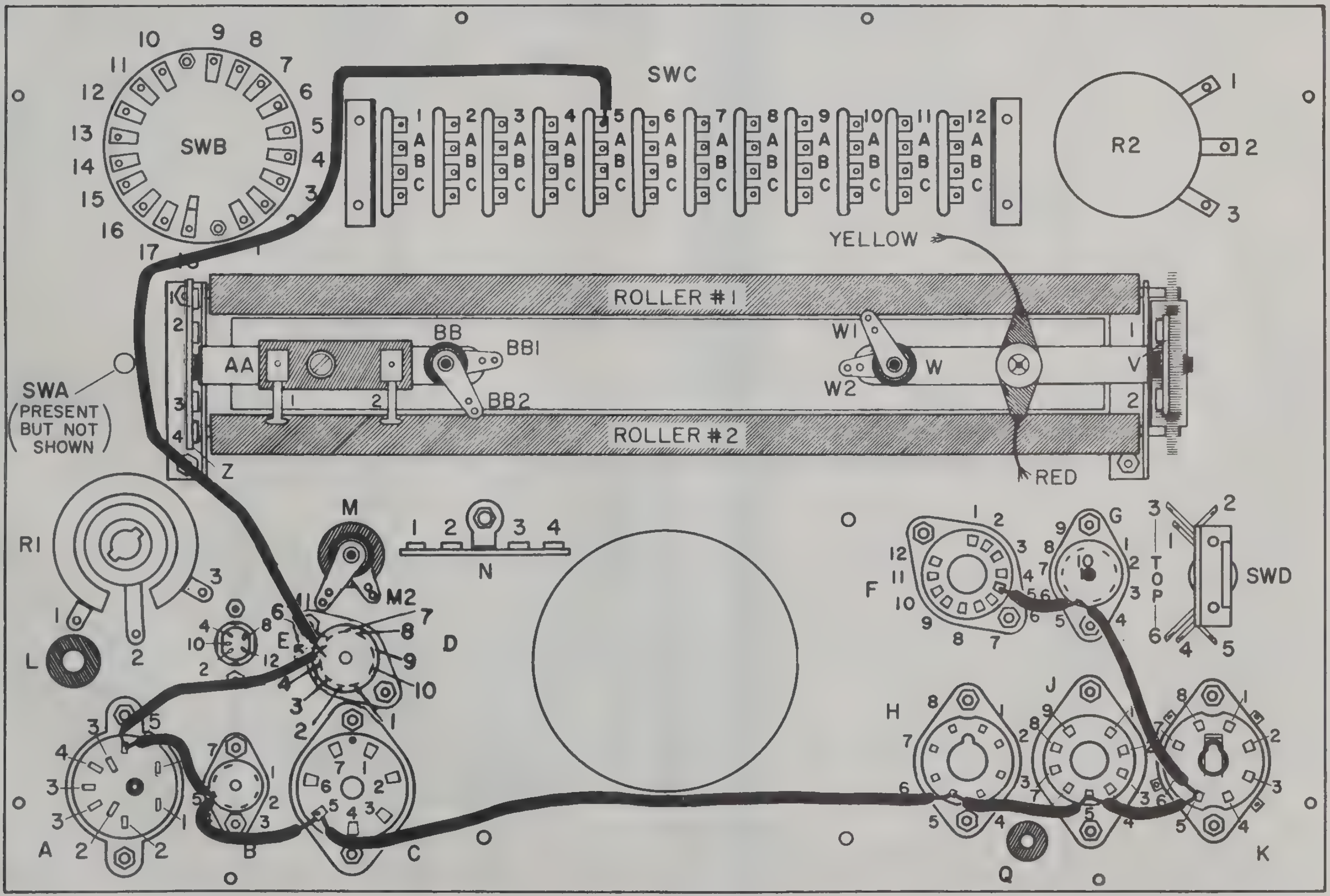
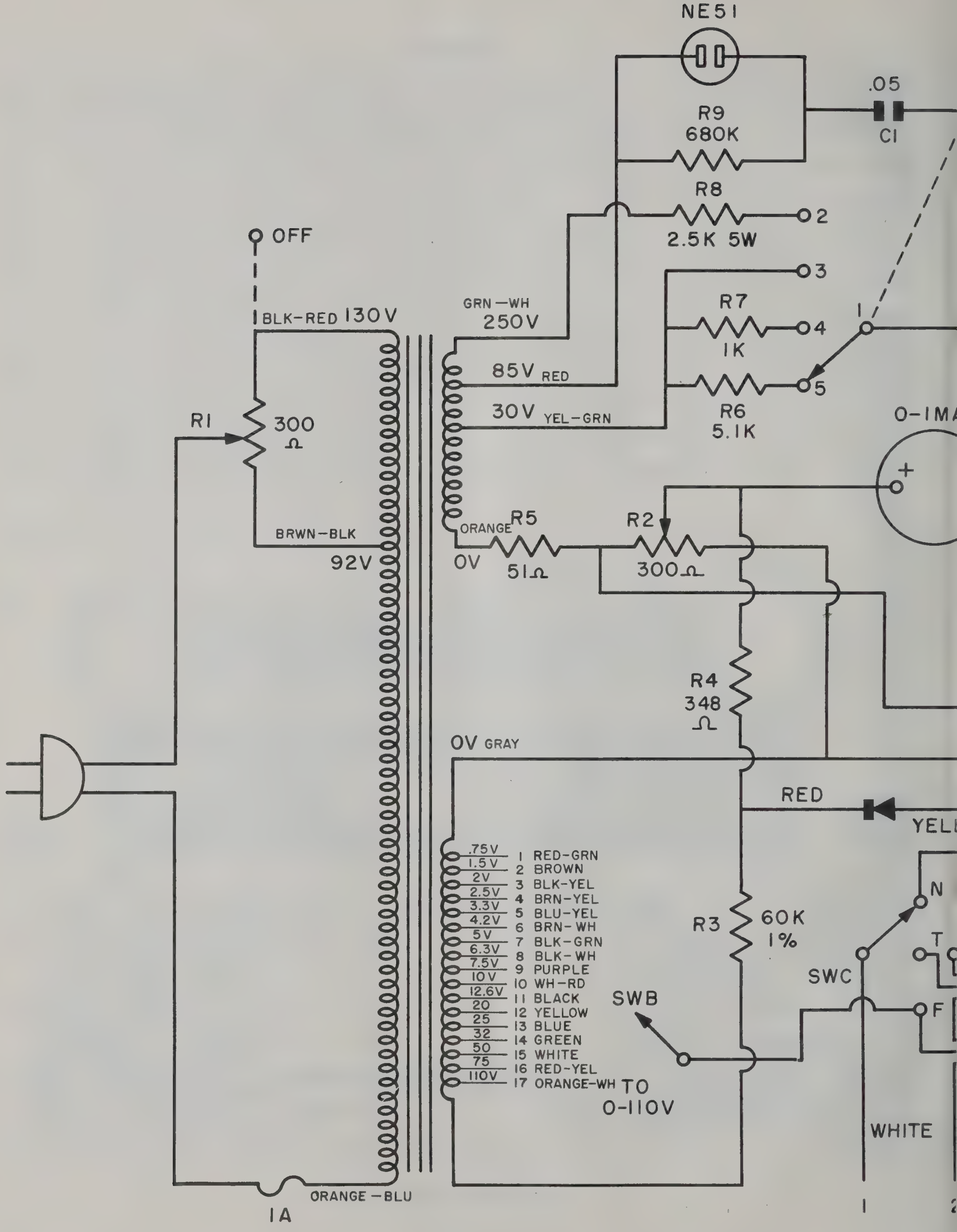
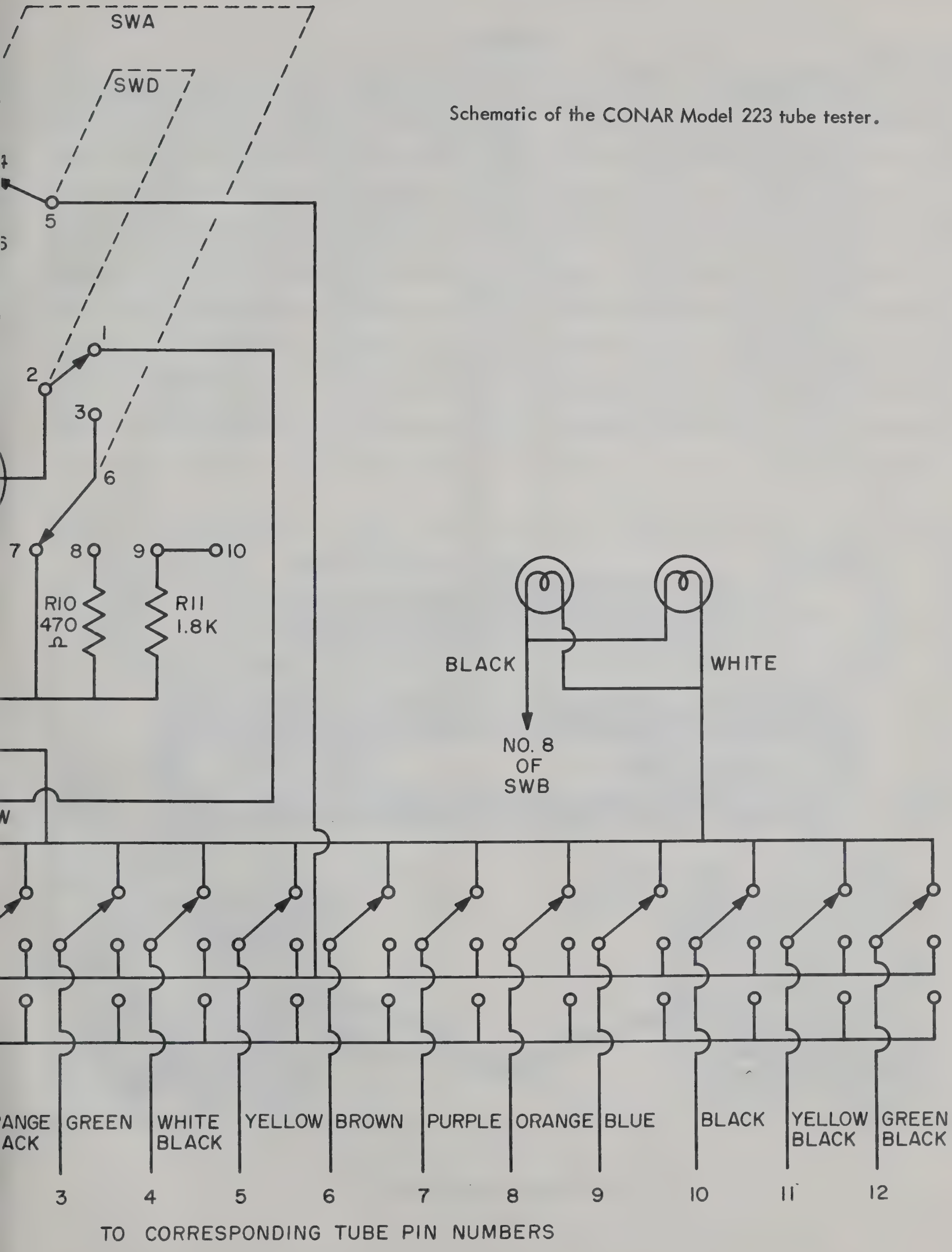


FIG. 16. Pictorial of wiring in Table 5.


NE51
.05
C1
R9
680K
R8
2.5K 5W
2
3
R7
1K
4
1
5
R6
5.1K
0-1MA
+
OFF
BLK-RED 130V
GRN-WH
250V
85V RED
30V YEL-GRN
R1
300
Ω
BRWN-BLK
92V
ORANGE
0V
R5
51Ω
R2
300Ω
R4
348
Ω
0V GRAY
RED
YEL
.75V 1 RED-GRN
1.5V 2 BROWN
2V 3 BLK-YEL
2.5V 4 BRN-YEL
3.3V 5 BLU-YEL
4.2V 6 BRN-WH
5V 7 BLK-GRN
6.3V 8 BLK-WH
7.5V 9 PURPLE
10V 10 WH-RD
12.6V 11 BLACK
20 12 YELLOW
25 13 BLUE
32 14 GREEN
50 15 WHITE
75 16 RED-YEL
110V 17 ORANGE-WH TO 0-110V
R3
60K
1%
N
T
SWC
F
SWB
WHITE
1
1A
ORANGE-BLU



Schematic of the CONAR Model 223 tube tester.

TABLE 6

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Brown 13-1/2"	17	6 SWC - 6D	6 SWC		
2	Brown 3-1/2"	17	6D - 6A	6D		
3	Brown 1-1/2"	17	6A - 6B	6A		
4	Brown 2-1/4"	17	6B - 6C	6B		
5	Brown 8-3/4"	17	6C - 6H	6C		
6	Brown 3-1/2"	17	6H - 6F	6H		
7	Brown 1-3/4"	17	6F - 6G	6F		
8	Brown 3-1/2"	17	6G - 6J	6G		
9	Brown 2-1/2"	17	6J - 6K	6J - 6K		

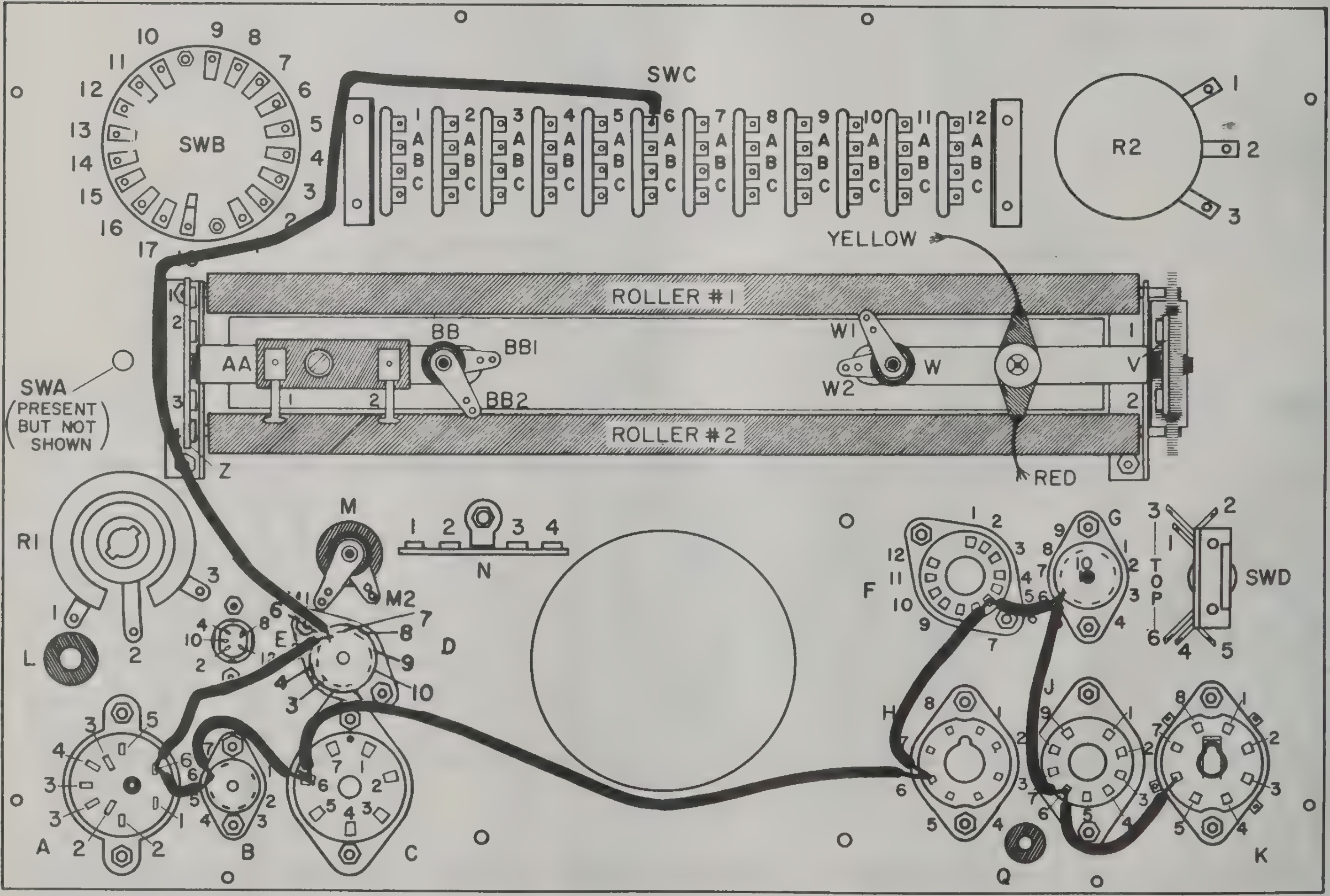


FIG. 17. Pictorial of wiring in Table 6.

TABLE 7

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Purple 13-1/4"	18	7 SWC - 7D	7 SWC		
2	Purple 2-3/4"	18	7D - 7B	7D		
3	Purple 2-1/4"	18	7B - 7C	7B		
4	Purple 8-1/2"	18	7C - 7H	7C		
5	Purple 2-1/2"	18	7H - 7F	7H		
6	Purple 2-3/4"	18	7F - 7J	7F		
7	Purple 3-1/4"	18	7J - 7G	7J		
8	Purple 3-1/2"	18	7G - 7K	7G - 7K		

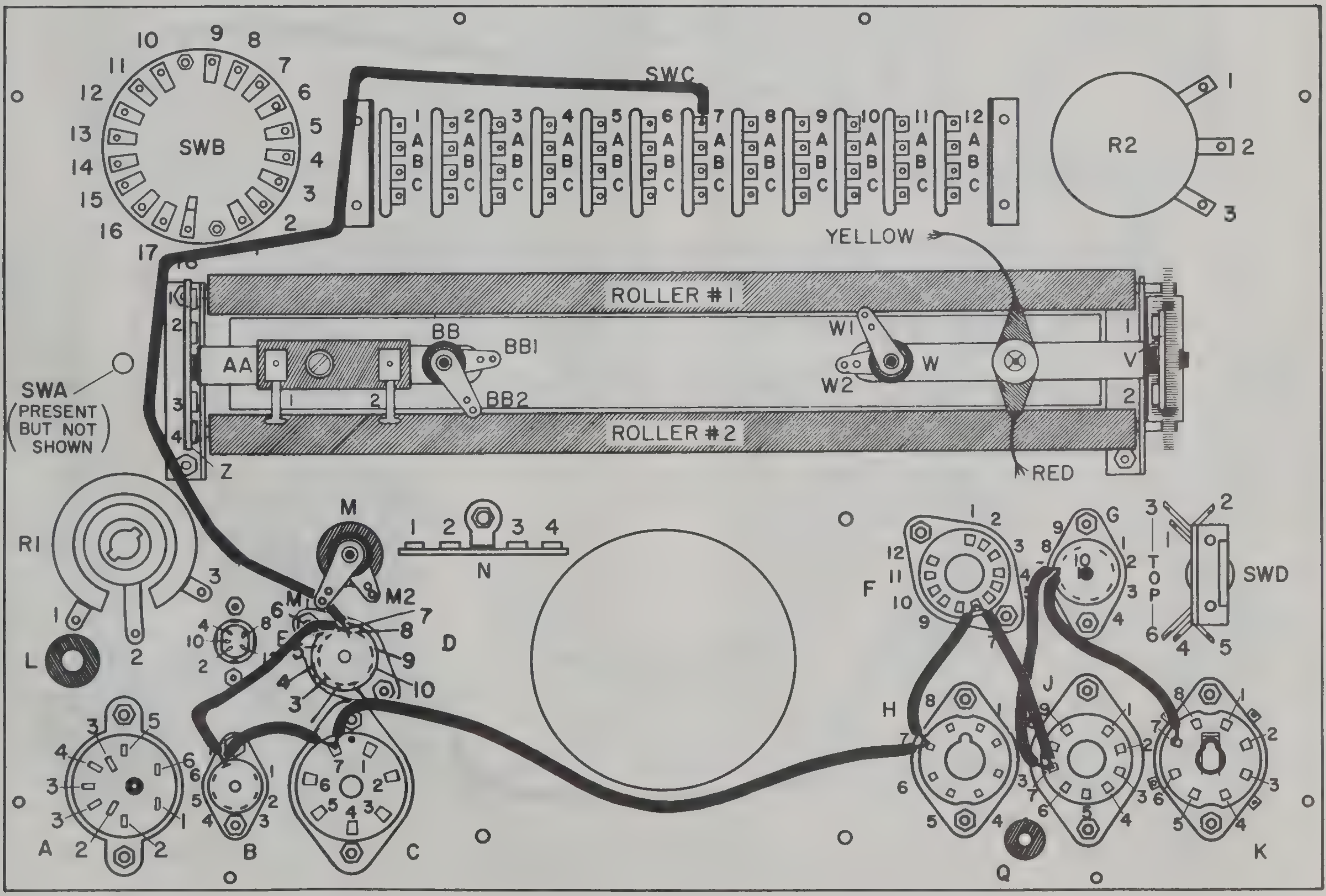


FIG. 18. Pictorial of wiring in Table 7.

TABLE 8

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Orange 1-3/4"	19	8E - 8D	8E		
2	Orange 11"	19	8D - 8H	8D		
3	Orange 2-1/2"	19	8H - 8F	8H		
4	Orange 2-1/4"	19	8F - 8G	8F		
5	Orange 3-1/2"	19	8G - 8J	8G		
6	Orange 3-1/4"	19	8J - 8K	8J		
7	Orange 14-3/4"	19	8 SWC - 8K	8 SWC - 8K		

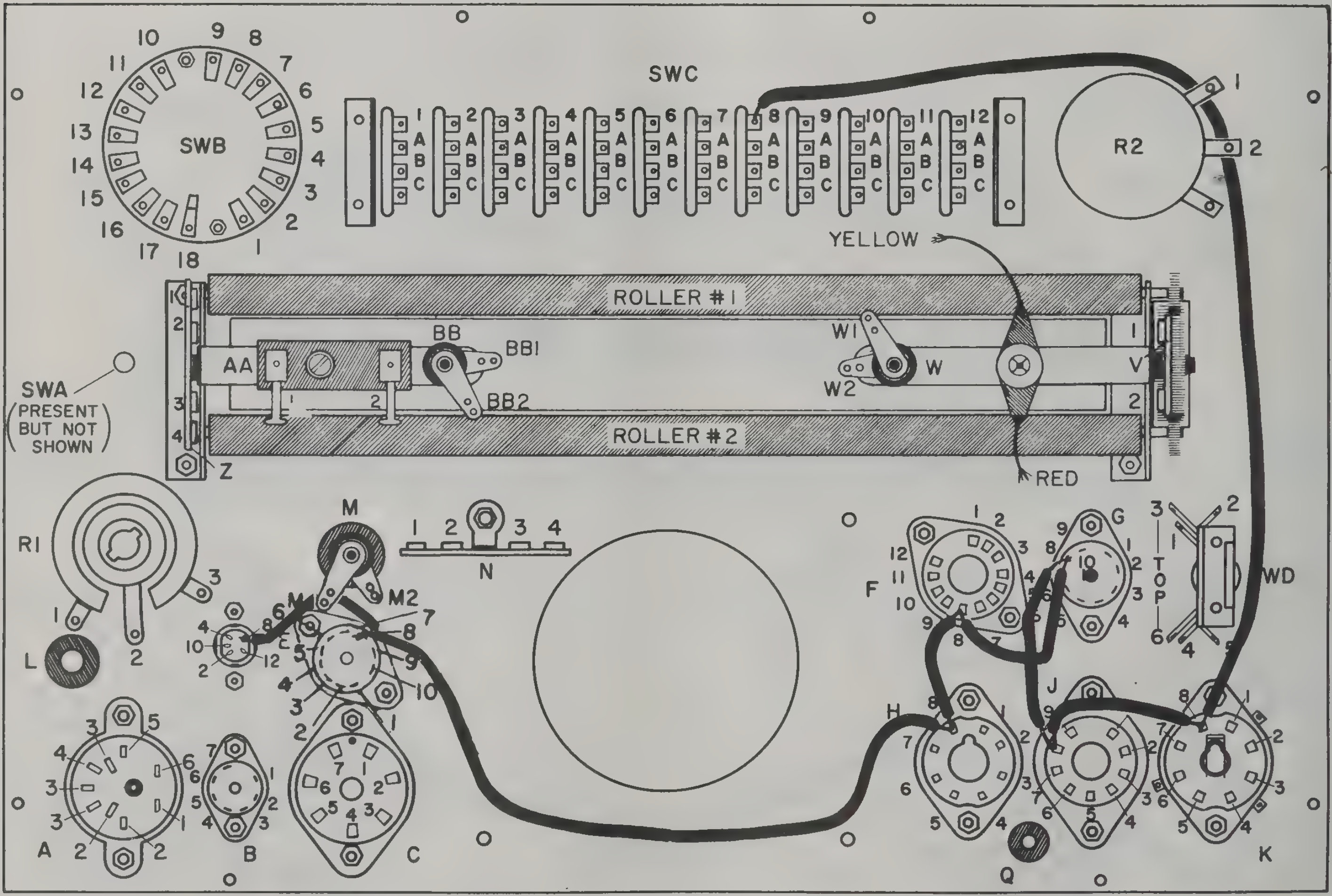


FIG. 19. Pictorial of wiring in Table 8.

TABLE 9

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Blue 11-1/2"	20	9D - 9F	9D		
2	Blue 3-1/2"	20	9F - 9G	9F		
3	Blue 3-1/2"	20	9G - 9J	9G		
4	Blue 14-3/4"	20	9 SWC - 9J	9 SWC - 9J		

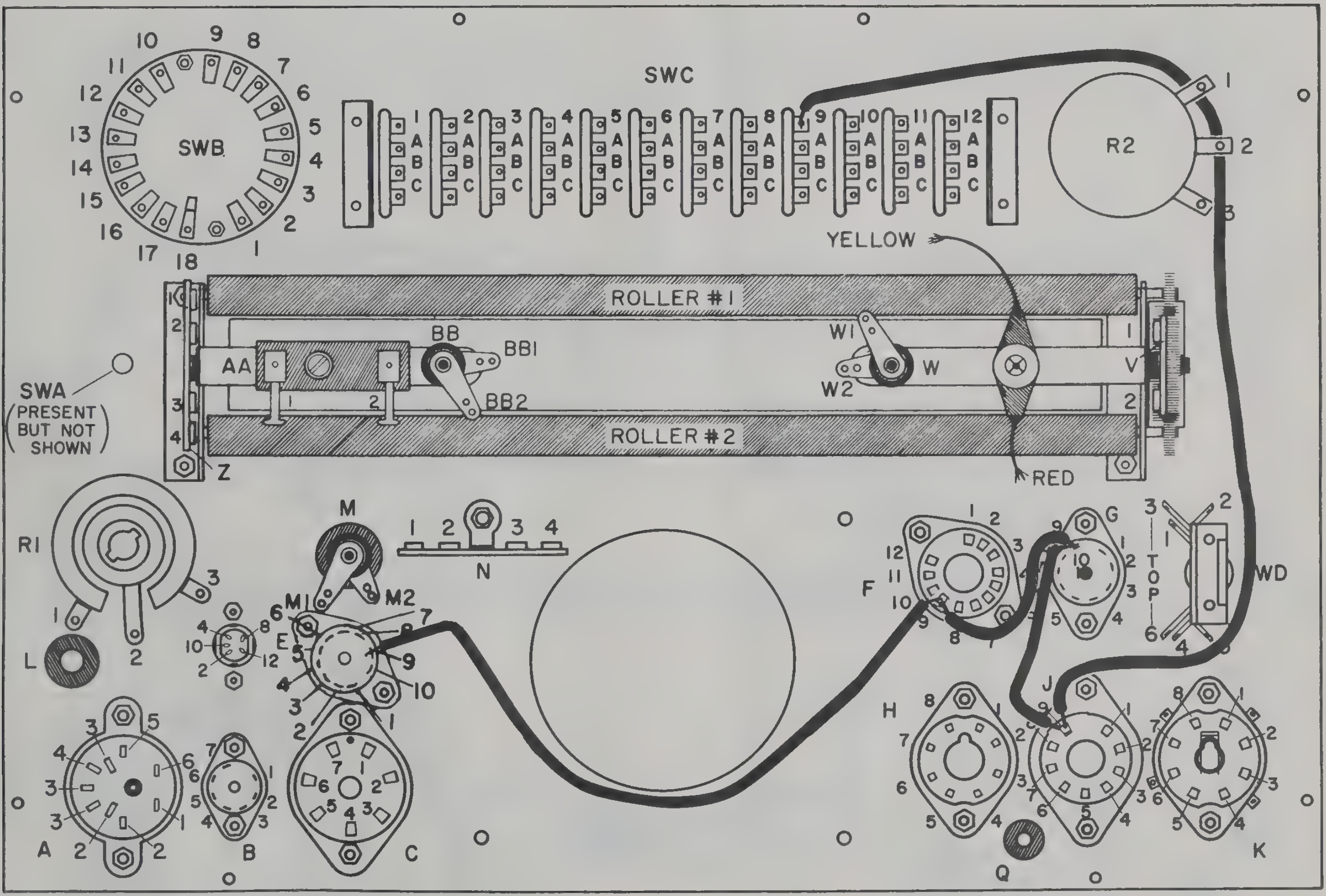


FIG. 20. Pictorial of wiring in Table 9.

TABLE 10

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Black 3-1/4"	21	10E - 10D	10E		
2	Black 11-1/2"	21	10D - 10F	10D		
3	Heavy Black 18"	21	Q - 10G	--		
4	Black 4"	21	10F - 10G	10F		
5	Black 14-1/2"	21	10 SWC - 10G	10 SWC - 10G		*

*Check to make certain all leads at 10G are soldered.

Assemble the heavy black lead and the grid clip as shown in the insert in Fig. 21. Pull the metal clip from the Bakelite cap so the bare end of the black lead can be pushed through the cap and soldered to the clip. The solder should lie flat on the lead and clip so the clip may be pushed back into the cap.....................( )

Now, from the front of the panel, push the other end of the black lead through grommet Q. Tie a knot in the lead so it cannot slip back through the grommet and so there will be about 5" of wire from the knot to its free end. Use a thin-bladed screwdriver to lift the wires between sockets H and J and F and G. Work the black lead under these wires, keeping it next to the panel and attach to pin 10 (center pin) of socket G, as shown in Fig. 21..( )

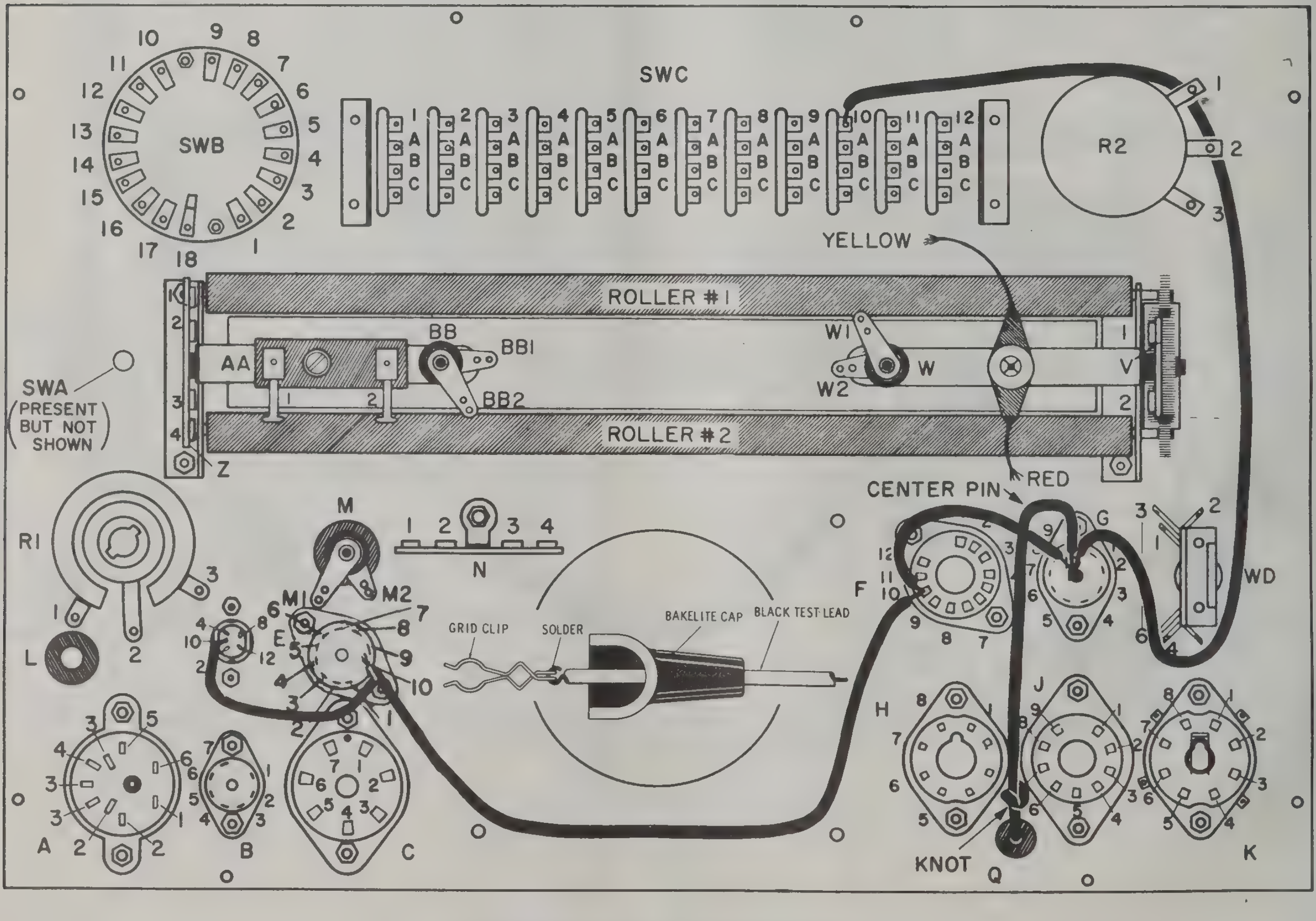


FIG. 21. Pictorial of wiring in Table 10.

TABLE 11

STEP	WIRE COLOR AND LENGTH	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	Yellow/black 16"	22	11 SWC - 11F	11 SWC - 11F		
2	Green/black 11-3/4"	22	12E - 12F	12E		
3	Green/black 15-1/2"	22	12 SWC - 12F	12 SWC - 12F		

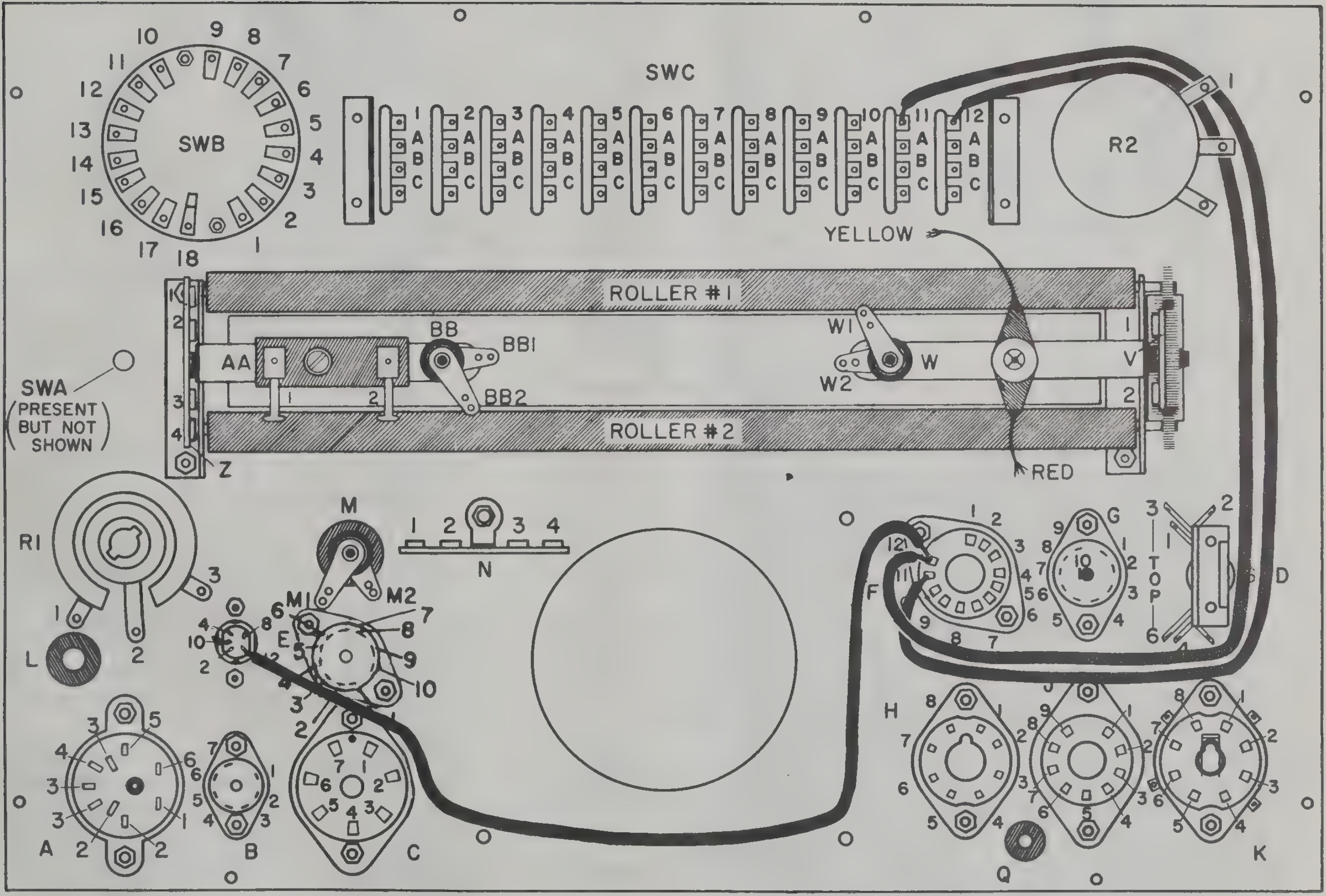


FIG. 22. Pictorial of wiring in Table 11.

GENERAL WIRING

At this time, all wiring except the power transformer and meter will be completed. You will need:

One bus bar wire (heavy bare)
  spaghetti
One power cord
One .05-mfd capacitor
One 680K-ohm resistor
One 60K-ohm 1% resistor
One 51-ohm resistor
One 348-ohm 1% resistor

When soldering bus wire on switch SWC apply solder to wire and lug; remove solder and draw iron on bus wire so that it will be soldered as well as lug.

Follow the instructions in Table 12.

TABLE 12

STEP	PART OR WIRE	SEE FIG.	SOCKET CONNECTION	SOLDER	CHECK	CHECK
1	9" bare bus wire 2-1/2" spaghetti	23	Through SWC12A, 11A, 10A, 9A, 8A, 7A, 6A, 5A, 4A, 3A, 2A, 1A, 2-1/2" spaghetti to SWB18.	All A lugs on SWC and 18 of SWB		
2	6-3/8" bare bus wire	23	Through SWC1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, 11B, 12B.	All B lugs on SWC except 12B		
3	Red wire 13"	23	SWC12B to SWD5	Both		
4	9-1/2" bare bus wire 2-3/4" spaghetti	23	Through SWC1C, 2C, 3C, 4C, 5C, 6C, 7C, 8C, 9C, 10C, 11C, 12C, 2-3/4" spaghetti to 3 of R2.	3 of R2. All C lugs on SWC except SWC1C		
5	6-1/2" twisted wires (black and white)	23	One end to BB1 and BB2, other to W1 and W2.	W1 and W2		
6	Red wire 9"	23	BB1 to 8 of SWB	BB1		
7	Red wire 8-1/2"	23	BB2 to SWC1C	BB2		
8	680K-ohm res. (blue, gray, yellow)	--	M1 to M2	NO		
9	348-ohm res., 1%	--	N2 to N3	NO		
10	60K-ohm res., 1%	--	N1 to N3	NO		
11	Red wire 10-3/4"	23	N3 to V2	N3		
12	Red wire of rectifier	23	to V2	V2		
13	Red wire 14"	23	N2 to 2 of R2	2 of R2		
14	51 ohm res. (green, brown, black)	2	Z3 to Z4	NO		
15	Red wire 20"	2	Z3 to 1 of R2	1 of R2 and Z3		
16	Yellow rectifier lead	23	to V1	NO		
17	Yellow wire 3-1/2"	23	1 of SWD to V1	1 of SWD and V1		
18	Red wire 15"	23	6 of SWA to 3 of SWD	3 of SWD		
19	.05-mfd capacitor	--	M2 to N4. Cut excess lead length	M2		
20	Red wire 10-1/2"	23	N4 to SWD4	BOTH		
21	Red wire 16-1/4"	23	1 of SWA to 6 of SWD	6 of SWD		

INSTALLING THE LINE CORD

Push the end of the line cord through grommet L from the front of the panel. Mark the line cord 7 inches from the tinned ends. Tie a knot in the cord so the mark is past the knot on the free end of the cord. Split the two leads down to the knot. Cut one lead 1-1/2" from the knot. Strip off 1/4" of insulation and solder this lead to 2 of R1. Bring the other lead around R1 near socket E along the chassis and up and around the roll chart bracket and terminal strip Z, guiding the lead with longnose pliers. Solder lead to 1 of AA. ....( )

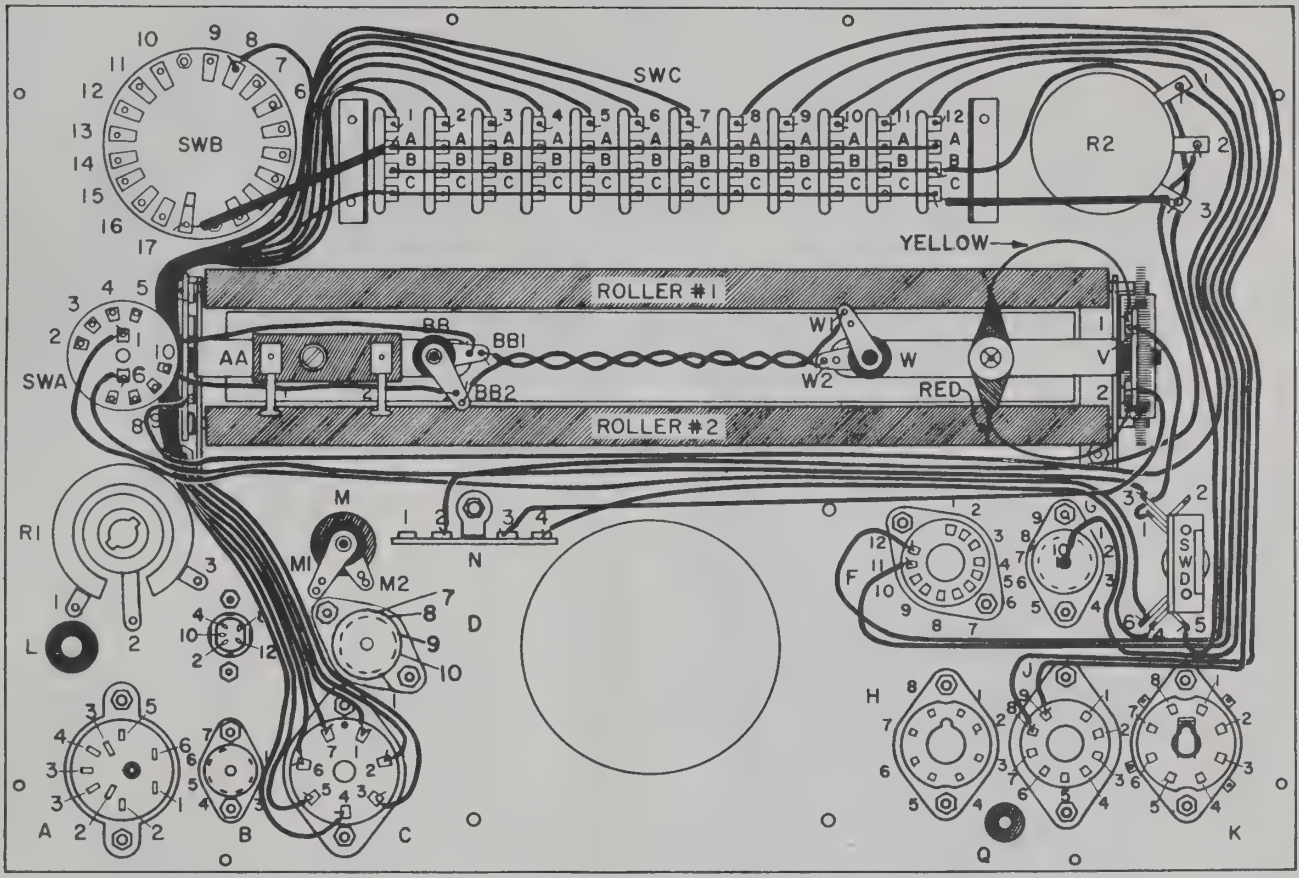


FIG. 23. Pictorial of wiring in Table 12.

MOUNTING AND WIRING THE METER

Remove and discard the screw and nut holding terminal strip N in place. Insert the meter from the front of the panel so its mounting screws go through the four holes provided in the panel, and one also goes through the mounting foot of terminal strip N; the meter screws will go only into the proper holes......( )

Connections will now be made to the two lugs on the back of the meter. With the panel positioned as in Fig. 24, the right-hand meter lug is positive. Connect a 5-3/4" red lead from the right-hand meter terminal to terminal N2. Solder N2 and the meter terminal. Push the wire straight down to the chassis from lug N2 and from the edge of the meter case................( )

Connect a 9-3/4" red lead from the left-hand meter terminal to SWD2. Solder both connections. Again bring the wire down to the chassis......................( )

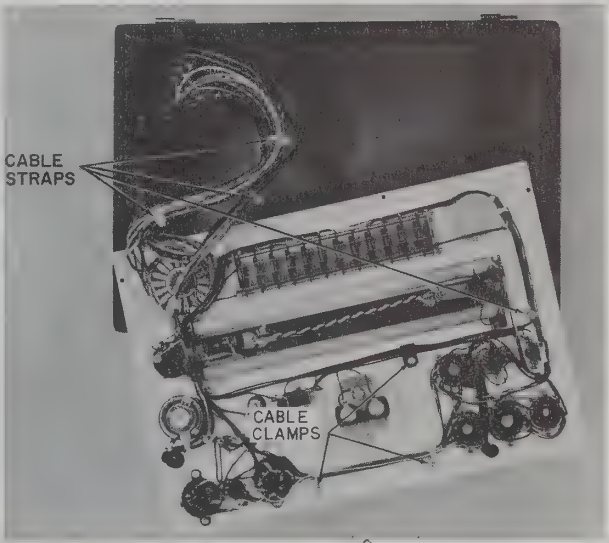


FIG. 24. Position of cable clamps around the wires and over the meter screws.

Place cable clamps around the wires and over the other three meter screws as shown in Fig. 24. Attach nuts to the meter screws and tighten firmly but do not force...( )

MOUNTING AND WIRING THE POWER TRANSFORMER

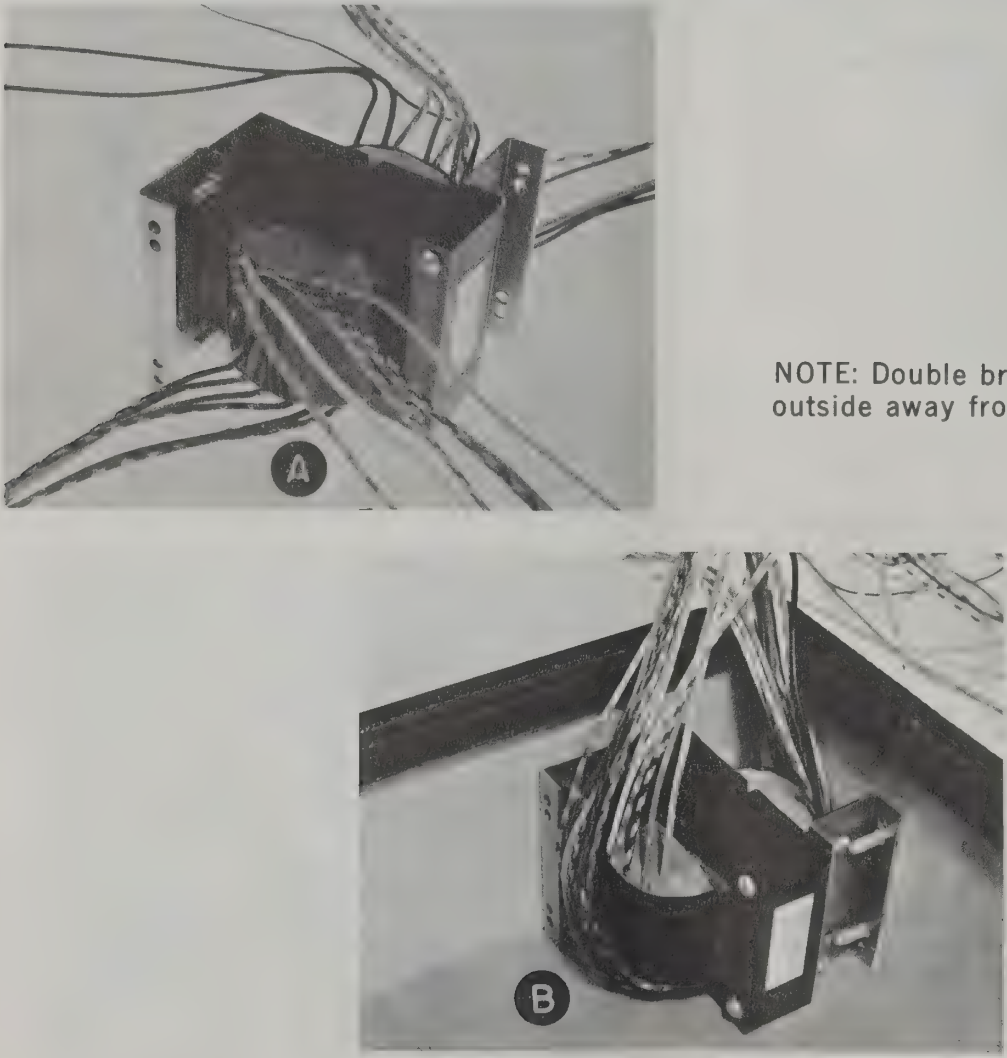
The power transformer will be bolted to the inside of the cabinet so there will be no strain on the panel.

Fasten the two mounting brackets to the transformer core with 1-1/2" × 8-32 screws, as shown in Fig. 25A. Draw the nuts up tight. ....( )

Now place the transformer in the cabinet, as shown in Fig. 25B, so the holes in the sides of the cabinet line up with the holes in the brackets. ....( )

Slip each of the four thread-cutting screws through a metal cup washer, through one of the cabinet holes and into the corresponding hole in the brackets. Drive home snugly with a heavy screwdriver. When the screw is partially in, backing it off a turn or so and then proceeding again makes the work easier. ....( )

To wire the power transformer, position the panel upside down on top of the cabinet (shown in Fig. 24). Fig. 26 shows where the various leads connect and this will aid you in properly positioning the leads. The instructions for wiring the power transformer are given in Table 13. ....( )



NOTE: Double brackets are on outside away from transformer.

FIG. 25. Attaching the mounting brackets to the power transformer.

When you have finished the transformer wiring, you will have two groups of wires. The large group runs from the transformer to the SWB switch; the small group goes past the switch to Z, R1, AA and M. Place cable straps around the two groups of wires as shown in Fig. 24. Bend the wires into a reverse letter "S" as shown. This will allow you to place the panel in its proper position in the case without interference.

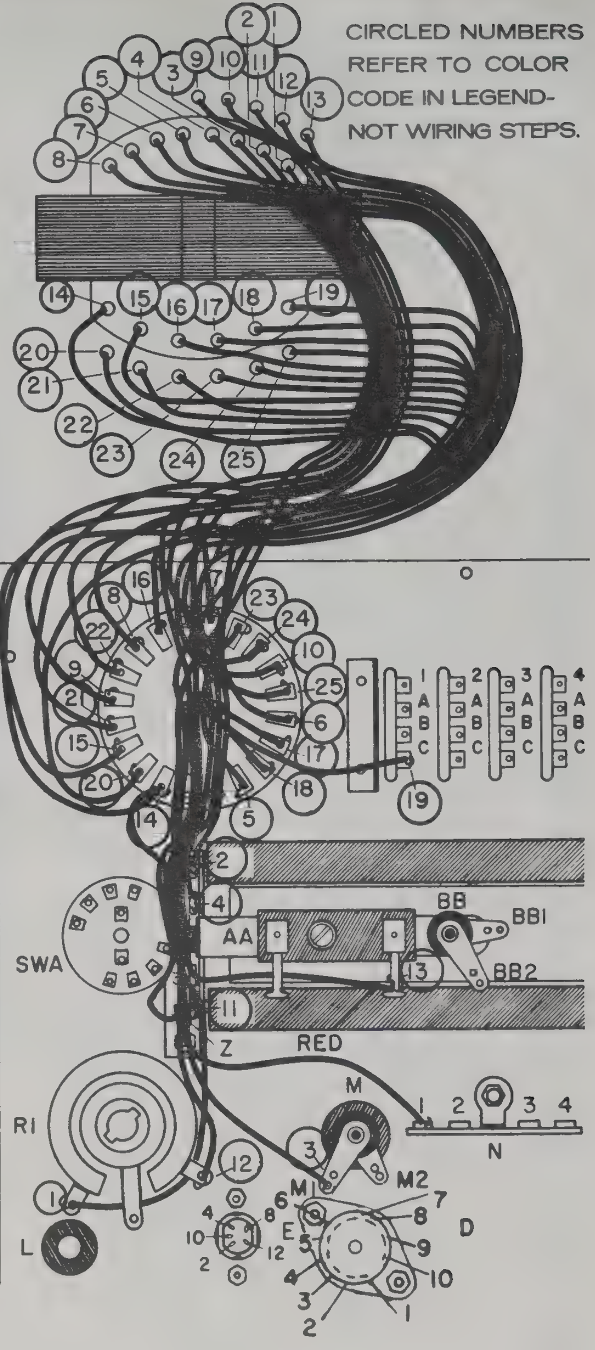
TABLE 13

STEP	TRANSFORMER LEAD OR WIRE	SEE FIG.	HOW ROUTED AND TO WHERE	SOLDER	CHECK	CHECK
1	Black/red	26	Between SWA and chart bracket, under all leads to 3 of R1.	YES	✓	
2	Brown/black	26	Between SWA and chart bracket, under 3 and 2 of R1 to 1 of R1.	YES	✓	
3	Orange/blue	26	Under power cord lead at 1 of AA to 2 of AA.	YES	✓	
4	Orange	26	Connect free end to Z4.	YES	✓	
5	Gray	26	Bring under all wires to SWC1C.	YES	✓	
6	Yellow/green	26	Connect to Z1.	YES	✓	
7	Red	26	Slip between SWA and chart bracket under leads between R1 and bracket to M1.	YES	✓	
8	Green/white	26	Connect to Z2, cut off any excess lead at Z2.	YES	✓	
9	Red/green	26	Connect to 1 of SWB.	YES	✓	
10	Brown	26	Connect to 2 of SWB.	YES	✓	
11	Black/yellow	26	Connect to 3 of SWB.	YES	✓	
12	Brown/yellow	26	Connect to 4 of SWB.	YES	✓	
13	Blue/yellow	26	Connect to 5 of SWB.	YES	✓	
14	Brown/white	26	Connect to 6 of SWB.	YES	✓	
15	Black/green	26	Connect to 7 of SWB.	YES	✓	
16	Black/white	26	Connect to 8 of SWB.	YES	✓	
17	Purple	26	Connect to 9 of SWB.	YES		
18	White/red	26	Connect to 10 of SWB.	YES		
19	Black	26	Connect to 11 of SWB	YES		
20	Yellow	26	Connect to 12 of SWB.	YES		
21	Blue	26	Connect to 13 of SWB.	YES		
22	Green	26	Connect to 14 of SWB.	YES		
23	White	26	Connect to 15 of SWB.	YES		
24	Red/yellow	26	Connect to 16 of SWB.	YES		
25	Orange/white	26	Connect to 17 of SWB.	NO		
26	Red wire 7"	26	N1 between SWA and roll chart bracket to 17 of SWB.	N1 and 17 of SWB		

LEGEND

LEAD IDENTIFICATION AND COLOR CODE

1. BROWN/BLACK
2. YELLOW/GREEN
3. RED
4. GREEN/WHITE
5. RED/GREEN
6. BROWN/YELLOW
7. PURPLE
8. BLACK
9. BLUE
10. BROWN/WHITE
11. ORANGE
12. BLACK/RED
13. ORANGE/BLUE
14. ORANGE/WHITE
15. WHITE
16. WHITE/RED
17. BLACK/YELLOW
18. BROWN
19. GRAY
20. RED/YELLOW
21. GREEN
22. YELLOW
23. BLACK/WHITE
24. BLACK/GREEN
25. BLUE/YELLOW



CIRCLED NUMBERS REFER TO COLOR CODE IN LEGEND-NOT WIRING STEPS.

FIG. 26. Pictorial of wiring in Table 13.

Fig. 27 shows the correct method of installing the cable straps. First, you wrap the band around with the teeth against the wires and thread the band through the clamp loop, as shown in Fig. 27A. ....( )

Then pull the band tight with fingers or pliers, as shown in Fig. 27B. Cut off excess band. ....( )

To finish up the back of the panel, remove the protective paper you placed around the roll chart; install the two pilot lamps in their holders and the fuse in its holder. ....( )

Lift the panel so the meter can be rotated up and away from you. When the panel is turned over, it will fit on top of the cabinet. Fasten the panel to the cabinet with the eight wood screws provided. ....( )

Now attach the black button knobs to the twelve levers of SWC and the red button knob to SWD.............( )

Attach pointer knobs to the shafts of SWB, SWA, and R1. The screws in the knobs should fit against the flat section of the shaft. This positions the knobs correctly. Rotate the shaft of R2 completely counterclockwise. Put on the knob so it points to the last mark to the left and tighten the set screw in the knob. ....( )

You are now ready to test tubes, but first read over the test procedure.

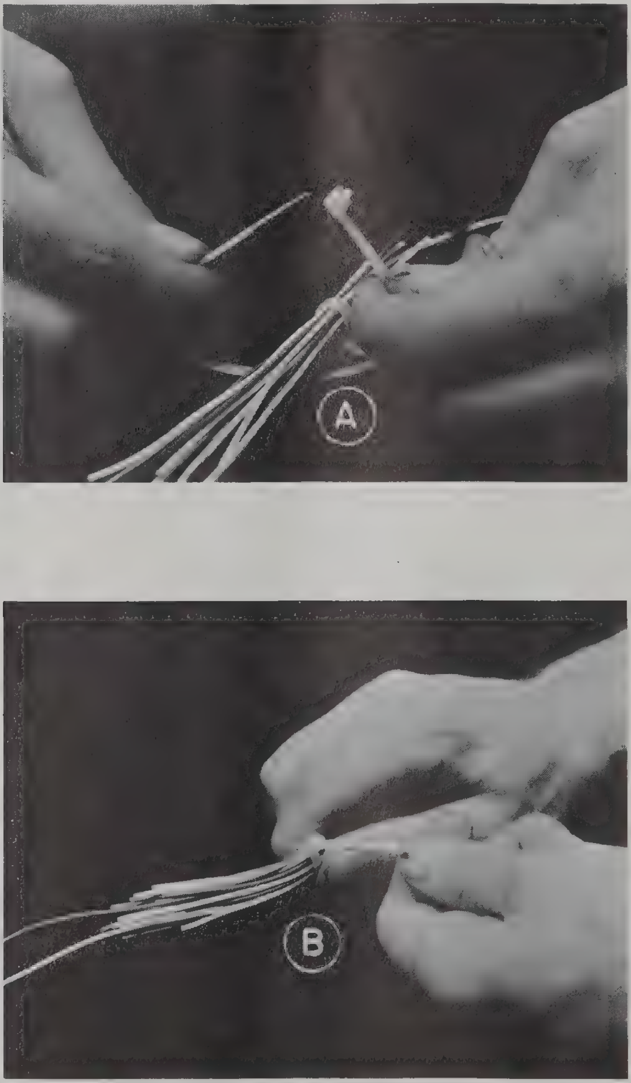


FIG. 27. Correct method for installing the cable straps.

Preliminary Tests

Examine the meter pointer; with no power applied, it should be over zero on the 0-100 scale. If the pointer is not zeroed, adjust it, using a small screwdriver to turn the plastic screw on the meter face.

Plug the power cord into a 115V, 60-cycle power outlet. Turn the Line Adjust clockwise. The pilot lamps under the roll chart should light up and you should be able to adjust the meter pointer to the Adjust Line at the center of the scale.

Next, one at a time, throw each of the lever switches to the Test position and back to NORMAL. Without a tube in the tester the neon short lamp should not stay lighted when a lever is in the TEST position. If throwing two levers causes the lamp to glow, a short between the circuits of these levers is indicated. For example, if throwing either levers 4 or 5 to TEST causes the neon bulb to glow, you should examine each socket for solder or a wire end bridging between pins 4 and 5. Such trouble can easily be found by inspection and corrected. If everything seems to be normal, further tests can be made by actually testing some tubes.

IN CASE OF TROUBLE

If the tester does not operate properly, we suggest the following tests:

1. Recheck all wiring and soldered connections. At this time look for wire clippings and small splatters of solder which could short tube socket terminals, switch contacts, terminal strip lugs, etc.
2. If an ohmmeter is available, check the continuity between lever switch contacts 1, 2, 3, ... 11, 12, and the various tube socket terminals having the same numbers.
3. Check the ac voltages shown on the schematic and make certain the transformer leads are connected to the proper switch terminals and other connection points.

INSTRUMENT DESCRIPTION

The heart of the Model 223 is the 12-lever switch. With this switch any tube pin can be connected to any one of the three circuits.

In the test position an ac voltage is applied through the neon bulb. If there is a conductive path between the tube electrode connected to "TEST" and any other electrode, the lamp will glow. In this way shorts and undesirable leakage between electrodes may be discovered; also filament continuity may be checked.

In the "C" position, the electrode is connected to a tap on the filament transformer chosen by the 17-position filament switch.

In the "NORMAL" position, the tube elements are connected to the "O" side of the filament winding of the power transformer and through the meter circuit to the test secondary of the power transformer.

With the proper lever set to "C", the tube filament is heated. All other electrodes except the cathode and other filament are connected to TEST. This connects the tube as a diode. When the Press-To-Read button is depressed, the neon lamp is disconnected from the circuit and a voltage chosen by presetting Switch A is applied across the diode-connected tube. At the same time, the meter is switched from measuring the secondary voltage and is placed in series to check the diode current. This current is indicated on the "GOOD - ? BAD" scale of the meter.

OPERATING INSTRUCTIONS

1. Connect the power cord to a 115 volt, 50-60 cycle source.
2. Move the roll chart to the listing of the tube to be tested.
3. From the chart, set switches A and B to the positions shown.
4. Throw the lever switch listed under C to the "C" row. All other lever switches remain in the NORMAL row at this time.
5. Set the D Control to the value under the "D" heading.
6. Insert the tube in the proper socket.
7. Turn the Adjust Line Control so the pilot lamps light and the meter pointer is over the Adjust Line on the meter scale. Filament continuity is to be checked at this time by moving the lever switch in the C position to the TEST position and then back to C. The neon lamp must glow in the TEST position. If no glow is seen, the tube filament is open and the tube is rejected without further tests. Ignore any momentary flashes of the neon lamp as the levers are moved since they are only the result of the capacitor in series with the lamp charging or discharging.
8. Throw the one or more switches, under the Cathode Shorts heading, at the same time to TEST and then back to NORMAL. The neon lamp should NOT glow when lever or levers are in the TEST position. A glow shows cathode leakage is present and the tube should be rejected without further tests. Tap the tube lightly when making this test to see if an intermittent short is present.
9. Continuity tests of elements which are supposed to be connected together inside the tube are listed under the data for the tube. Throw such levers one at a time to TEST and then back to NORMAL. The neon lamp must glow when each lever is in the TEST position. If there is no glow, reject the tube without further tests.
10. Throw each lever listed under the TEST row, one by one in the order listed in the chart. The neon lamp should NOT glow unless otherwise indicated on the roll chart. A glow indicates a shorted condition and the tube should be rejected without further tests.

Tap the tube lightly as each lever is put in the TEST position to reveal any intermittent shorts.

11. When all levers under TEST are in position, depress the Press-To-Read button and observe the quality of the tube on the meter.

Should you suspect an open exists in one of the pins connected in the TEST position, this may be easily checked. Return all levers that were in the TEST position to normal, and while holding the Press-To-Read button down, throw each of the levers in question to TEST and then back to NORMAL. If throwing a lever to test results in no movement of the meter needle, that electrode has an open connection to its base prong and the tube is defective. Bear in mind that the reading on some elements may be slight (less than one division) but if there is any meter pointer movement the element is not open. In case of doubt, make this test, even though the tube may test in the "GOOD" scale in the first step, when all necessary levers are in the TEST position.

KEY TO LETTER ABBREVIATIONS INDICATING TUBE SECTION UNDER TEST

a = Amp
d = Diode
e = Eye
h = Heptode
he = Hexode
I = Input
o = Output
p = Plate
pe = Pentode
r = Rectifier
s = Section
t = Triode
te = Tetrode
to = Total

SPECIAL TESTS

1. "EYE TESTS" (Electron ray type indicator tubes)

NOTE: For a complete short test on "EYE" tubes, watch for neon lamp glow when the indicated levers are thrown to the TEST position same as is done for all other tubes.

(a) Single Target Type. This type is typified by types 6E5 and 6G5. For example, the roll chart data for the "EYE" section of type 6E5 appears as follows:

TUBE		A	B	C	D	SHORTS	TEST
6E5	EYE	4	8	1	0		2-4

The following test procedure must be used:

1. Set all switches and controls as indicated on the roll chart for "eye."

2. Press the READ METER button and observe the circular fluorescent screen which should illuminate completely. Disregard meter indications.

3. Throw the first of the two levers indicated under the TEST heading (lever 2 in this example) to the NORMAL position. A good tube will now exhibit a typical angular shadow. Return the same first lever to its original TEST position and observe closure of the shadow.

(b) Double Target Type. This type is typified by types 6AD6 and 6AF6. For example, the roll chart data for type 6AD6 appears as follows:

TUBE		A	B	C	D	SHORTS	TEST
6AD6	EYE	4	8	2	0	8	3-4-5

Test procedure is as follows:

1. Set "A", "B", "C", and "D" as indicated on the roll chart.

2. Perform cathode short test by throwing lever 8 to the TEST position and back to NORMAL position, observing neon bulb for "short" indication while lever is in TEST position.

3. Set levers 3, 4, and 5 to the TEST position and observe neon bulb for "short" indications.

4. Press the READ METER button and observe the circular fluorescent screen which should illuminate completely. Disregard meter indications.

5. Throw the first of the three levers under the TEST heading (lever 3 in this example) to the NORMAL position. A good tube will now exhibit a typical angular shadow.

6. Throw the second of the three levers under the TEST heading (lever 4 in this example) to the NORMAL position. A good tube will now exhibit another angular shadow, opposite the position occupied by the first shadow.

7. Return levers 3 and 4 to the TEST position and note closure of the shadows.

(c) FM/AM Tuning Indicator Tubes. An example of this type electron ray tube is type 6AL7, the roll chart data for which appears as follows:

TUBE		A	B	C	D	SHORTS	TEST
6AL7	EYE	1	8	*2	0	8	1-3-4-5-6

*(6AL7 - Also throw 4-5-6 to "C")

Test procedure is as follows:

1. Set "A", "B", "C", and "D" as indicated on the roll chart.
2. Perform cathode short test.
3. Set levers 3, 4, 5, and 6 to the TEST position and observe neon bulb for short indications.
4. Throw levers 4, 5, and 6 to the "C" position.
5. Press the READ METER button and note the two rectangular fluorescent patterns on the screen of the tube. Disregard meter indications.
6. With the READ METER button depressed, throw the first lever listed in the parenthesis note (lever 4 in this example) from its "C" position to NORMAL position. One rectangular pattern should become

shorter in length.

7. With the READ METER button still depressed, throw the third lever listed in the parenthesis note (lever 6 in this example) from the "C" position to the NORMAL position. The other rectangular pattern should then become shorter in length.

8. Throw the second lever listed in the parenthesis note (lever 5 in this example) from the "C" position to NORMAL position. Both patterns should then become shorter in length from the ends opposite to those previously affected. Observe the ends closely as the movement may be slight.

2. SPECIAL RECTIFIER TEST (Types 70A7, 117N7, and 117P7)

Because of unusual internal connections (one side of the filament connects to the plate), the rectifier sections of types 70A7, 117N7, and 117P7 require special test procedures. Caution must be exercised in performing these tests, to minimize the possibility of filament burn-out.

(a) 70A7 - Rectifier Section.

1. Set "A", "B", "C", and "D" as indicated on the supplementary chart.
2. Perform cathode short test.
3. After the tube has heated sufficiently, throw levers 2, 6, and 7 RAPIDLY to the TEST position, and QUICKLY depress the READ METER button. The first meter indication obtained is the significant one, since the pointer will quickly fall back as the tube filament cools. Make absolutely certain all three levers (2, 6, and 7) are in the TEST position before the READ METER button is depressed.

(b) 117N7 and 117P7 - Rectifier Section

1. Set "A", "B", "C" and "D" as indicated on the supplementary chart.
2. Perform cathode short test.
3. After the tube has heated sufficiently, throw levers 2 and 7 RAPIDLY to the TEST position, and QUICKLY depress the READ METER button. The first meter indication obtained is the significant one, since the pointer will quickly fall back as the tube filament cools. Make absolutely certain both levers (2 and 7) are in the TEST position before the READ METER button is depressed.

3. GAS TYPE RECTIFIERS

When testing gas rectifier types such as 0Y4, OZ3, and OZ4, it will be noted that the meter pointer will remain in the REPLACE sector for a brief period and then deflect quickly into the GOOD sector. This condition is normal for a good gas rectifier. Should the pointer remain in the REPLACE sector after several seconds have elapsed, the tube should be rejected.

4. TUBE-BRAND VARIATIONS

In determining the tube test limits for this instrument, CONAR engineers have spent considerable time checking tubes from the production runs of leading tube manufacturers. From the information gathered, the data on the roll chart accompanying this instrument has been compiled.

Due to the fact that extensive research is constantly being made in the television and radio tube industry to improve and stabilize tube characteristics, it is not uncommon for a manufacturer to make a change in the specifications of a particular tube. This change, though perhaps not readily noticeable in set performance, may become apparent when the tube is tested on your CONAR Model 223, and necessitate a new test limit for that particular type.

Therefore, should a particular type be found to vary consistently from the assigned average roll chart limits, simply determine the new average setting for control "D" that will produce a reading of approximately 70 on the 0-100 scale directly below the three color "Quality" scale.

Keep in mind that consistently high or low reading for any particular manufacturer's tubes of a certain type are not necessarily indicative of a poorer or better run of tubes or a defect in your tube tester.

SPECIAL SUBSCRIPTION SERVICE

New Tube Test Data

In line with CONAR's desire to extend utmost service to builders and users of CONAR test equipment kits, new Tube Test Data is available periodically as new tubes are introduced. You will be notified automatically as this data becomes available.

ACCESSORY ADAPTERS AVAILABLE FOR YOUR TUBE TESTER

CONAR Stock No. 3AD Picture Tube Adapter Cable is designed to adapt the Model 223 to the Emission test of all types of modern picture tubes with the exception of 110° types.

CONAR Stock No. 5AD picture tube adapter cable is designed to adapt Stock No. 3AD cable described above to the emission test of both types of modern 110° picture tubes.

MAINTENANCE SUGGESTIONS

Your CONAR Tube Tester is capable of fulfilling continuous daily service requirements over a period of many years. However, in order for you, the user, to fully realize these capabilities, the same degree of care in operation and maintenance should be accorded your instrument that would be given any other fine piece of equipment.

There is always the possibility that repairs will be necessary with any piece of test equipment. Should your tube tester require servicing, just remember that the same logical processes of elimination apply as they do for any electrical circuit, and you should experience no difficulty. The checks outlined under "WHAT TO DO IN CASE OF TROUBLE," will aid you considerably. Proper operating voltages are shown on the schematic. A variation of ± 20% in these readings is entirely acceptable.

Should failure of the meter movement coil be suspected, the continuity may be checked with an ohmmeter if a limiting resistor of approximately 10KΩ is first connected in series with the ohmmeter test leads. NEVER test meter coil continuity directly with an ohmmeter. Excessive current from the ohmmeter battery will invariably ruin the meter coil and will definitely result in an open condition.

Do NOT attempt repair of the meter movement coil at any time. This will automatically void our standard warranty coverage of the meter movement.

Should the clear plastic meter cover become damaged, you may obtain replacement of the cover only from CONAR Instruments. To remove the cover, insert a small screwdriver of knife blade under one of the upper corners and gently pry upward. This is a friction fit, and it should pop right off. When installing a new cover, be careful to properly engage the small plastic stud on the cover with the slotted zero adjust lever on the meter movement. Do not leave the meter movement exposed to the air for any length of time. Accumulations of dust and other foreign matter can seriously impair the operation of this delicate instrument. Should you find it necessary to have the plastic cover rēmoved for any time, protect the movement by enclosing it in a box.

The clear plastic meter cover may occasionally, through repeated polishing or cleaning, accumulate charges of static electricity. This will cause the pointer to deflect erratically regardless of whether the instrument is tuned on or off. These static charges may easily be removed by using one of the commercially available anti-static solutions or a solution of any good liquid detergent (of the type used for washing dishes) and water. Simply dip a clean, soft cloth in the solution and wipe the surface of the meter cover. The cover need not be removed for this operation.

$I = E \div R$

$I = \frac{.96}{1000} = .00096$

$\frac{6000}{1000} = 6.$ ma

$\frac{18,000}{100} = 18$

$\frac{1,8000}{3300}$

$33.00 \overline{)18.000}$ 5
16500
1500

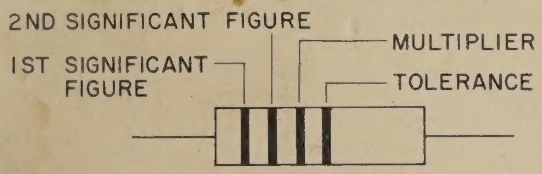
5.5

RESISTOR AND CAPACITOR COLOR CODES

JAN and EIA stand for the two common color codes (Joint Army-Navy and Electronics Industries Association). The two codes are the same except as indicated. We have not indicated temperature coefficients or characteristics of capacitors, because they are not necessary for identifying your parts.

COLOR	SIG. FIG.	MULTIPLIER	RESIS.	TOLERANCE			
				CERAMIC CAPACITORS		MICA CAPACITORS	PAPER CAP
				10 MMF OR LESS	OVER 10 MMF	(As below, or ± 1 mmf, whichever is larger)	
Black	0	1		± 2.0 MMF	± 20%	± 20%	20%
Brown	1	10		± 1.0 MMF	± 1%	± 1%	
Red	2	100			± 2%	± 2%	
Orange	3	1000			± 2.5%	± 2.5%	
Yellow	4	10,000					
Green	5	100,000		± 0.5 MMF	± 5%	± 5% (EIA)	5%
Blue	6	1,000,000					
Violet	7	10,000,000					
Gray	8			± 0.25 MMF			
White	9			± 1.0 MMF	± 10%		10%
Gold		.1	± 5%			5% (JAN)	5%
Silver		.01	± 10%			10%	10%
No color			± 20%				20%

RESISTORS — RESISTANCE GIVEN IN OHMS

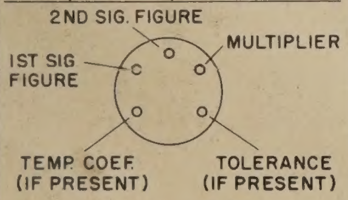


Black body = composition, non-insulated.
Colored body = composition, insulated.
Double width band for 1st sig. figure indicates wire-wound.

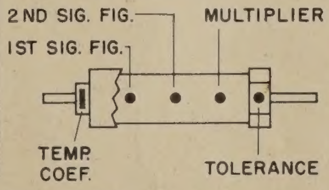
CAPACITORS — CAPACITY GIVEN IN MMF

CERAMIC

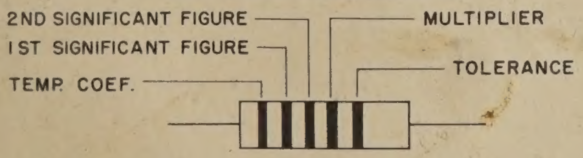
DISCS, BUTTON, OR FEED-THRU



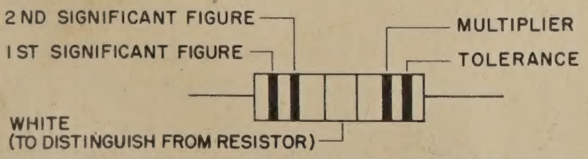
STAND-OFF



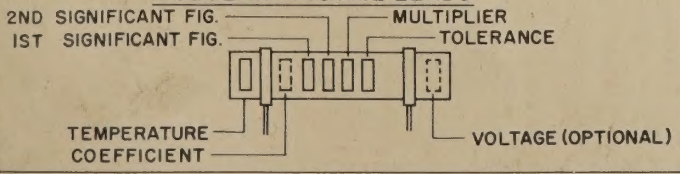
TUBULAR-AXIAL LEADS



—OR—



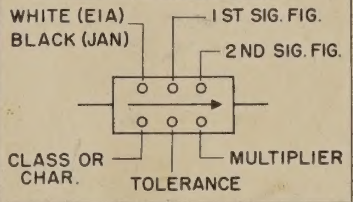
TUBULAR-PIGTAIL LEADS



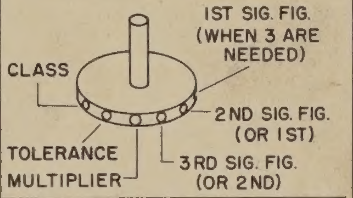
MICA

CLASS OR CHARACTERISTIC REFERS TO Q FACTOR, TEMPERATURE COEFFICIENT, AND PRODUCTION TEST REQUIREMENTS

FLAT MOLDED

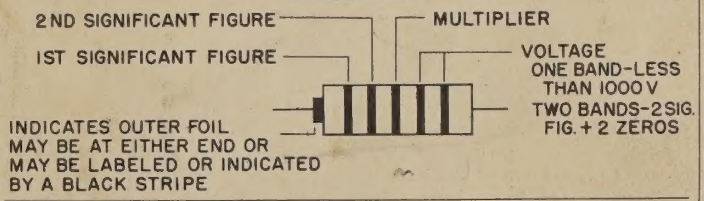


BUTTON SILVER



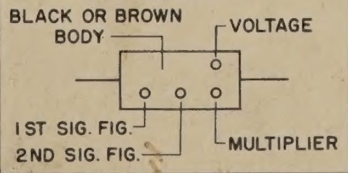
PAPER

TUBULAR


2ND SIGNIFICANT FIGURE
MULTIPLIER
1ST SIGNIFICANT FIGURE
VOLTAGE
ONE BAND-LESS THAN 1000 V
TWO BANDS-2 SIG. FIG. + 2 ZEROS
INDICATES OUTER FOIL MAY BE AT EITHER END OR MAY BE LABELED OR INDICATED BY A BLACK STRIPE

FLAT

EIA CODE



JAN CODE